Engineering and Mining Journal

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DREDGING FOR GOLD—THE BUCKET LADDER

Core Control in Drilling Alluvial Gold Deposits

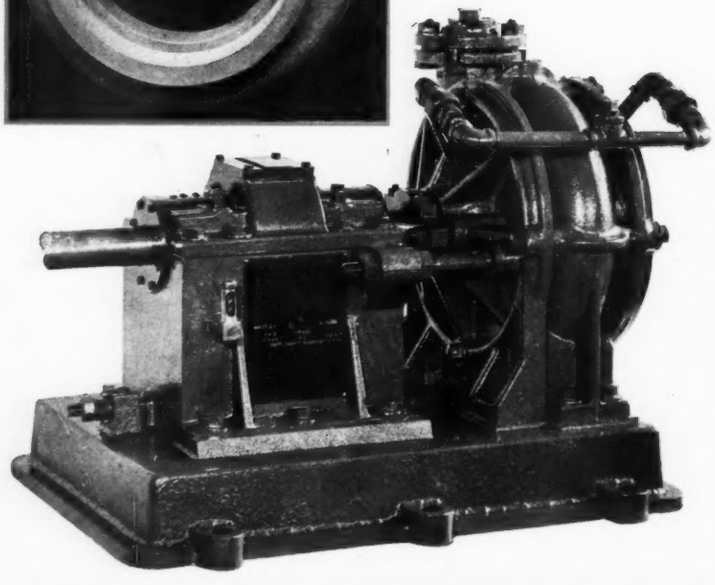
The Polarograph—An Instrument for Quantitative Chemical Analysis

pression Developments in Fluorspar Milling

Sampling and Classification of Atmospheric Dust

JULY, 1934

MAXIMIX rubber pump casing outlasts best metals 4 to 1



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COVER DESIGN. The familiar bucket ladder of a gold dredge appears in new dress, the bas-relief effect being produced solely by a photographic process developed by J. A. Lucas in the photo laboratory of McGraw-Hill.

•

FAMILY TRADITION. Dr. John Herman, author of an article on the polarograph in this issue, recently received his doctorate at Charles University, in Prague, where his father received a degree 100 years ago. A long line of Hermans—members of the nobility in Bohemia until 1620—were also graduates of Charles University.

•

ORGANIC CHEMISTRY is something that the mill man must study if he is to work intelligently with flotation. This must be readily apparent to anyone who has read the three articles on the fundamentals of the process, by G. R. M. del Giudice, which were published in the April, May, and June issues, respectively. The August number will contain the fourth and last of the series.

•

HOMESTAKE MINING, late last month, jumped 25 points on the "big board" in two days, to above 400. As the highest priced active stock on the list, it recalls to many the "days that were."

•

THE LURE OF GOLD and the prospect of a boom in gold-mining stocks lead the National Better Business Bureau to take a paternal interest in the innocent investor. In response to many inquiries about gold-mining promotions, the Bureau has issued a primer of information designed to encourage the practice of investigating before investing.

H. O. KING, says the NRA, is the "exception that proves the rule." Mr. King will "boss-up" the copper industry, and would appear to be applying the old bromide "the proof of the pudding is in the eating," assuming that the recipe for the Copper Code was largely his.

•

FALSE TEETH, old watches, and wedding rings are producing more gold bullion than the nation's mines, the Treasury Department reports. Attracted by the Government's offer of $35 an ounce for gold, citizens have sold to the Government since last Feb. 1, $57,483,744 in scrap gold. The Western mines, working full speed because of the $35 price, were able to produce but $49,771,000 of gold during the same period.

•

SURVEYING WITH A THERMOCOUPLE has been added to available geophysical prospecting methods by J. N. A. Van Den Bouwhuijsen, a Hollander in this country. This physicist declares he has checked the instrument named against the gravity balance with good results. He will shortly describe his work for *E.& M.J.* readers.

•

A MAMMOTH GOLD DREDGE. What is said to be the largest bucket ladder in the world is one of the features of a dredge now nearing completion at Hammonton, Calif. The Yuba company is the builder. It will be described in an early issue.

•

CASTLE-TREHEWEY MINES more than doubled its liquid assets since closing its mine a few years ago. Investments in other mining companies turned the trick, proving that there is more than one way of making a mine pay.

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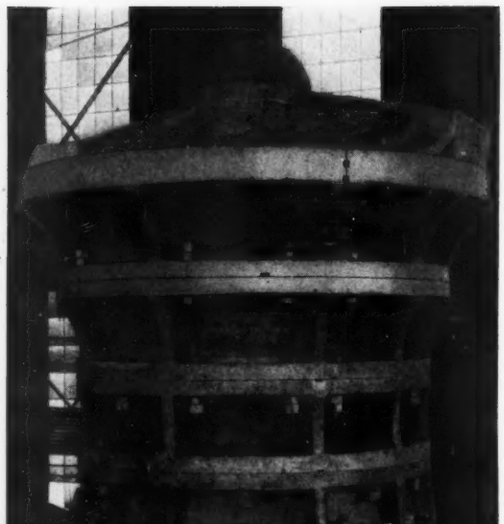

Photo shows 60″ machine, thirty feet high, weighing one million pounds.

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Labor Relations Still A Challenge to Management

ABANDONMENT of efforts to push the Wagner Labor Disputes Bill through the last session of Congress was tacit admission on the part of the Administration that this much-amended instrument would not effectively meet the situation. Likewise the hurried passage of the Labor Disputes Joint Resolution, at the behest of the President, was further evidence of the fact that sound labor legislation has not yet been conceived. The Joint Resolution was obviously a stop-gap, a tentative expedient limited in life to one year.

• As matters now stand the President may appoint a board or boards to investigate issues in labor disputes arising under Section 7(a) of NIRA, and to conduct elections of employee representatives for collective bargaining. But no new ideas have been advanced. That the Wagner bill suited neither labor nor management is evidence that a fair formula has not yet been derived nor a suitable mechanism set up to insure a reasonable degree of industrial peace.

• The problems of employer-employee relations remain a challenge first of all to intelligent management and may well receive primary attention in the months ahead. The situation calls for something more than stolid resistance to the demands of labor organizations. Unless those demands are forestalled by wise policies, or met with counter proposals of obvious merit, management will be open to the criticism of failure. The need of the hour is new ideas, not mere opposition to the existing order, no matter how unreasonable or fallacious it may seem to be.

• There are wise and progressive leaders in the mining industry who have put their heads as well as their hearts into the establishment and preservation of sound industrial relations. One such is the new president of the Canadian Institute of Mining & Metallurgy, Mr. S. G. Blaylock, general manager of the Consolidated Mining & Smelting Company, at Trail, B. C. He expects to mark his administration of the Institute by trying to bring to the mining engineering profession the importance of congenial relationship between the engineering and managing group and labor. In his judgment labor is becoming better educated and thus better qualified to play an intelligent part in the industry. Hence he feels that management would be well advised to see to it that labor groups are fully informed regarding conditions in their respective companies and in the industry, rather than leave them exposed to the incendiary statements of irresponsible outsiders. The success of his own policies lends authority to his views.

• Labor relations remain the most unsettled and disquieting problem of the recovery period. Disputes have been settled as they arose, and interpretations of the law have been made to meet emergencies. But no national policy has been evolved that is broadly applicable. The only major principle that has been established in law is the right of employees to bargain collectively, but in the absence of clear-cut interpretation it carries in its wake a host of unsettled questions that make its administration unsatisfactory if not impossible. That this principle will prevail in some form is likely. But in what form? Labor has spoken. What are the views of management?

The Business Outlook

THAT the state of business during the first six months of this year has been better than the state of the collective business mind is an assumption justified by reference to the figures. The *Business Week* index for 1934 shows a remarkably steady trend of activity at about 65 per cent of normal, in marked contrast to the continuous decline from August, 1929, to March, 1933, and the erratic course during the remainder of the latter year.

Explanation of the lower mental state is probably to be found in the fact that Congress was in session and that much regulatory legislation would be passed. The reaction was one of apprehension and waiting. In the meantime business proceeded on a fairly steady keel. Congress has now adjourned, and business will have an opportunity to adjust itself to new conditions. Morale should improve in spite of the usual summer slump, and by fall both business and the business mind should be hopefully looking up again. The general outlook is far from discouraging.

Minerals and Debts

JUDGING from subsequent governmental activities, Secretary Hull's suggestion to Great Britain that war debtor nations might consider "payment in kind" was more than a mere gesture. The idea is being taken seriously in Washington that the Government might accept foreign minerals in part payment of international debts, and the possibilities of such an arrangement are being explored by federal agencies.

Admittedly there would be advantages to the Government in accepting minerals as debt payments. They would have a tangible value that is now lacking in evidences of debt that are in default, and would to that extent relieve American taxpayers. But it is equally certain that the proposal offers complications. Indiscriminate import of minerals might prove more detrimental to domestic economy than would a permanent lapse in cash payments.

Highly technical questions are involved. They demand study by mineral economists as well as by those officials who determine the affairs of State. Here evidently is a task for the President's recently appointed Planning Committee for Mineral Policy. That agency has been wisely selected to include men who know the mineral industries intimately and have their welfare at heart. The committee should be consulted before the State Department makes even tentative offers to foreign debtors.

If the Government should embark on negotiations seeking mineral imports, there must first be a clean-cut decision as to who will handle the business and who will own and use the goods when received. Such imports as the Government can hold as a military reserve would not disturb industrial trade. If any imports are to be brought in for resale by the Government, then the existing trade agencies should serve as the commercial aid of the Government, presumably working through the Export-Import Bank.

These matters are at an early stage of consideration. It is too soon to be seriously disturbed by them. They may only accomplish the definite result of making foreign debtors admit that they do not wish to pay, which will be quite a different matter than inability to pay. But whatever the result, the mineral industry may rightly demand cautious procedure, keeping in mind the welfare of domestic industry as well as the possibility of getting some payment on debts.

Dredging Increases in California

BENEFITS ACCRUING to the gold-placer mining industry from the enhanced price of gold are characteristically demonstrated by the results in the gold-dredging areas of central and northern California. The difference between $20.67 and $35 per ounce of gold has had salutary effects on employment and production. It has made possible the working of lower-grade gravel, with consequent acceleration of prospecting and development programs to enlarge the scale of operations and the life of the gold-dredging industry. During the past year numerous projects involving heavy capital expenditures have been started, and many new or dormant gold-bearing placer areas have attracted serious attention with a view to their exploitation. It is estimated that not fewer than nine new gold-placer dredges, including the mammoth dredge of Yuba Consolidated Gold Fields now nearing completion at Hammonton, or an increase of over 40 per cent in dredging equipment, will be added to the existing fleet of dredges by the end of 1934. As to employment, building of these new units has provided work for both skilled and unskilled labor in the mining districts, as well as in foundries and plants in the Bay Region.

Twice Told Geophysical Tales

INSPECTION of the literature that has appeared on the subject of geophysical prospecting in the last few years reveals that various articles retraverse well-trodden ground, somewhat unnecessarily. Inasmuch as this objectionable practice has seemingly been on the increase, attention may well be called to it in the hope that it will be curbed.

The mining world is still eager to learn of new developments in geophysical work. Interest naturally does not run as high as it did a decade or more ago, when few engineers knew much of this particular branch of science, and the instruments and methods used seemed vested with mystery as well as with possibilities for profit. Since that time, papers galore on the various aspects of the difficult subject have been read; much real progress has been made, and the mining operator in general has come to recognize that in geophysics the geologist has an additional useful tool, especially for studying structures. Where its application directly to ore finding is concerned, he undoubtedly would like to have more facts as to the discoveries actually made, even after granting certain notable achievements. As it probably seems to him, the talk at times has gone beyond the corroborating data.

Just what has been accomplished by the geophysicist in the way of ore discovery? Much undeniably has been achieved, but just how much? The question is appropriate at a time when new efforts are being made

to impress upon the mining public, much of it without previous experience, the great advantages of a geophysical survey. If the facts could be brought together by some qualified and unbiased person, the summary would be worth while. Unfortunately, completeness could not be hoped for in such a compilation. Too many reports are left unpublished in company files. In many cases, moreover, the drilling or development necessary to establish the accuracy of the work has not yet been completed, perhaps not even undertaken. In this respect, the geophysicist is at a disadvantage. The remedy, however, is not to be found in exuberance of statement or in frequency of publication, unless something new can be contributed to the science and the art.

Silicosis and the Missing Link

NO OTHER ONE SUBJECT, during the past twelve months, has had focused on it as much attention on the part of the mining industry, both here and abroad, as has silicosis. Much of the increased interest in this highly important health hazard, particularly that evident among those associated with its technical and medical aspects, has been the result of an announcement made about a year ago by a British geologist, to the effect that the mineral sericite was a principal factor in the causation of the disease. This investigator, Dr. W. R. Jones, has, in brief, undoubtedly done more to inspire a renewed and more aggressive research attitude with respect to silicosis than has any other worker in recent years. The interest that the announcement of a year ago aroused in the industry is in itself a noteworthy tribute to the importance of Dr. Jones's discovery and to the technique that he developed in the course of his investigations. Now comes word, moreover, that the Council of the Institution of Mining and Metallurgy (London) has awarded to him the "Consolidated Gold Fields of South Africa, Ltd.," gold medal, together with a premium of forty guineas, for his researches on the mineral residues of silicotic lungs.

Eradication of silicosis in mining, as well as in the construction, glass, pottery, and other industries, would seem to be morally obligatory, for the disease is essentially a man-made malady—one that is almost wholly a development of the machine age. Dr. Jones has undoubtedly made a major contribution in reaching this humanitarian goal. The mining industry at large cannot fail to recognize the excellence of the judgment responsible for the award, and it will join in the hope expressed by the recipient, who, at the time the award was made, referred to his endeavor as being a link between that of the pathologists on one hand, and that of the mining engineers on the other—the missing link, if that claim were not too great.

U. S. Mineral Resources Pattern

IT IS GENERALLY RECOGNIZED that the United States is generously endowed with mineral resources in ferrous and non-ferrous metals, coal, petroleum, gas, and a wide variety of non-metallics. The average annual value of their production during the decade 1923-1932 was close to four and one-half billion dollars. Every State in the Union contributed its share, but the relative importance of the States varied greatly. Which are the principal mining States? Are they in the West or in the East?

A map recently prepared by the United States Bureau of Mines portrays in striking manner the mineral production by States. Within the borders of each State is a circle, the size of which is proportional to the average annual value of mineral output, 1923-1932. Each circle is divided into four segments, colored as shown in the legend, to indicate the relative production of four general classes of minerals—metallics, nonmetallics, petroleum and gas, and coal. A glance at the map reveals a striking pattern of mineral deposits. The States immediately south of the Great Lakes stand out as an important mining area, with coal as the principal product. The great iron deposits are in Minnesota and northern Michigan. The non-metallic area extends along the Atlantic Coast, including every State from Maine to Florida. Petroleum and gas are localized in the South-Central States, excepting California, and the non-ferrous metals come principally from the States covered by the mountain chains of the Rockies and Sierra Nevadas. The map is an excellent aid in visualizing the pattern of United States mineral deposits as well as the value of mineral production.

Silver as a Bactericide

FIVE YEARS AGO we made editorial reference to a report from Germany that a scientist at Greifswald University had discovered a new use for silver in the sterilization of water for drinking purposes (*E.& M.J.*, April 13, 1929). Apparently, considerable work has been done in the interim on the commercial development of the process, and German literature abounds in references to its use. Interest in the subject in this country has received impetus through the activities of a research fellowship established at the Bureau of Standards by a group of silver producers, and by the independent organization of an American company to exploit the German process.

According to published information, the so-called catadyn method of water purification depends on the influence of very small quantities of ionic silver dissolved in water. Bacteria are not killed immediately, but, depending on the number of germs as well as on the properties of the water, are killed in 30 minutes or more. Water thus treated takes on batericidal properties that persist as long as the silver remains in requisite quantity.

In application of the process, water or other liquid to be sterilized is passed through an activator. This is an iron vessel lined with a special insulating substance, containing electrodes of pure silver connected with a source of current. At a maximum voltage of 1.6 and a current varying from 0.02 to 10 amperes, according to the size of the plant, silver is ionized into solution with bactericidal effect.

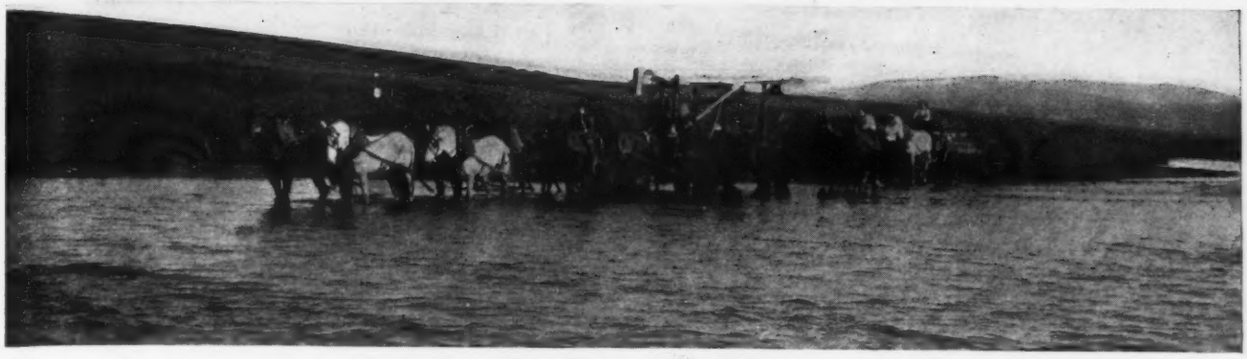
The mining industry's interest in the process lies in a potential industrial use for silver. Once used, the metal is not recoverable, for it is consumed in the method of sterilization. Hence the application of the process on a large scale in sterilizing domestic and industrial water supplies and food products holds prospect of a recurring demand for silver that might reach substantial proportions.

H. O. King

Managing Director of the Copper Code Authority

◆

IN SELECTING H. O. KING as managing director of the Copper Code Authority the industry has paid a decided tribute to the man who did most in formulating the Code. By reputation practical and tolerant in conferences, the new director is at the same time possessed of an intimate knowledge of the problems of the copper industry, as a result of intensive study given them while Deputy Administrator of the NRA. His long investigation which led to the drafting of the marketing section of the Code was conducted from a neutral viewpoint, and he may be counted on to maintain his neutrality in his new office. His background has been one of business. In 1915, at the age of 25, he started the firm of Otis, King & Co. to manufacture tools and dies. Eight years later, he organized the Bassick-Alemite Corporation and became vice-president and general manager of the Bassick Company, of Bridgeport. Retiring in 1928, he became affiliated with H. E. Talbot & Co., of New York, engaging in banking, investment and business management. He is a director of several companies. His connection with the NRA began last summer.



Transporting a Keystone drill used by Mr. Clark in Alaska

Core Control In Alluvial Drilling

A Method for Determining From the Extracted Gravel the Total Amount Called for by the Drive

V. V. Clark

Mining Engineer
Colorado Springs, Colo.

● WRITING *from a drilling experience that stretches over 24 years, Mr. Clark recommends the method of core control, here described, as the best he has known. In instances where it has been used, subsequent dredging has checked the sampling closely. Since the method first came to his attention eleven years ago he has improved it in various ways, and he anticipates that other operators will be able to add refinements. The author stipulates, however, that if the system is to work, enough holes must be drilled systematically to permit the law of averages to be used in computation. To get the best results, moreover, equipment must be improved and drill runners should be trained accordingly.*

THE discrepancy between the amount of gold obtained by pumping gravel from a driven pipe and that which should be in the gravel called for from the total core of the pipe has presented one of the great field problems of the placer mining engineer. It has been most baffling. A number of attempts have been made to solve this problem, and articles have been written by engineers who have tried to adjust the discrepancy after all of the core had been pumped out of the pipe and settled in a calibrated container, after completion of the hole, but the result was still unsatisfactory.

These steps were undoubtedly in the right direction. The difficulty, however, has always been to obtain an adjustment factor which could be used not only for varying conditions of formations penetrated by the pipe, but when the gold values are scattered through the gravel column from surface to bedrock. These variables offer many combinations which cannot be taken care of by any one adjustment factor.

In 1923, John D. Hoffman, a mining engineer from California, and I were assigned to drill a tract of dredging ground in South America which had previously been drilled by a well-known engineer and was considered unprofitable. The tract involved several millions of yards of gravel and was adjacent to ground that had been drilled by the same engineer, but which had overdredged something like 25 per cent. The last circumstance was the bait which prompted the owners to try to put the tract in the profit class.

The tract before us was a clay-gravel formation. The gold was fine and flaky, a combination not only difficult to drill accurately but likewise to dredge and obtain a reasonable recovery of the gold. A Keystone rig had originally been used in drilling the ground, and the logs indicated that the cores had generally been driven out by heavy pumping.

While we were considering a method of attack, Mr. Hoffman explained to me a system of core control which he had used in California on similar ground where subsequent dredging checked the drilling closely. We had two Empire hand drills at our disposal, and after he had explained and demonstrated the scheme to me by actual drilling in the field, I accepted the method for use in our drilling campaign.

I am not certain that Hoffman originated the idea. It runs in my mind that it had an evolutionary development. Since he taught me the method I have improved it, more in its application than in the procedure itself. In the meantime Hoffman has passed on. He died in Albuquerque, New Mexico, in 1930.

The following notes presuppose a knowledge of the mechanics of hand and powered drills for alluvial drilling, the principles underlying their respective uses, and accepted methods of

computing average values per cubic yard from drive shoe measurements and other factors.

To afford an idea of this method of core control I will give a simple example of a drill hole where conditions are about normal. In Fig. 1 is shown a form of drill log which can be modified as occasion demands, and which shows an average drive in average gravel which produced a normal core.

In this case let us assume that the hole has been started and carried down through the overburden to 10 ft. One will note that for a 12-in. drive the core in the casing was 15 in. This is about normal on the basis of a 25 per cent swell. Anything between 14 and 17 in. may be considered normal, as the degree of accuracy of drilling operations in general does not warrant closer figures. We considered, as a general rule, that ordinary gravel swelled 25 per cent in the casing, and that a loss of 1 in. in 7 in. occurred in slime overflowing from the cylinder. A gravel totally free from clay, or one containing a high percentage of clay mixed with it, would have to be tested for swell and overflowing slime separately if the best results were to be obtained from this system.

For measuring the gravel as received from the pump the cylinder should be of the same internal diameter as the casing used. It should be at least 18 in. high, have a tight bottom, and be provided with a stiff wire bale.

The pump is first discharged into a launder sufficiently long and wide to receive it lying flat. It is thoroughly washed in the launder, the gravel being conveyed into the measuring cylinder by means of a funneled spout. The cylinder rests in a container, preferably a gold pan, from which the overflow after settling is poured back. Then the depth of the contents of the cylinder is measured with a ¼-in. rod accurately divided into inches. The gravel in the cylinder is now ready for panning.

In the example given in Fig. 1 the core pumped was 13 in. After being pumped, it measured 12 in. in the cylinder. As a rule gravel and sand settle a little more compactly in the cylinder than they do in the casing after swelling subsequently to driving, and the cylinder measurement is therefore a little less. The figures cited may be accepted as being within the range of accuracy of the drilling. In other words, the example represents a normal case in all respects, and if the hole continued so, one would have only to weigh the total gold and apply the theoretical factor of so many feet of hole to the cubic yard of gravel.

The reader will observe in the sample drill log, in Fig. 1, that we reversed the order of numbering the colors. The reason was that when training drill runners to use this system of core control, of which classifying the gold colors pumped is a part,

Figs. 1, 2, and 3—Drill Log

Tract_____ Started Drilling_____ Total Depth_____ ft.
Line No._____ Finished Drilling_____ Depth to Bedrock_____ ft.
Hole No._____ Driller_____ Dredging Depth_____ ft.
Elevation_____ Panner_____ Water Level_____ ft.

Date	Length of Casing	Depth Driven	Total Depth	Core After Driving	Core After Pumping	Core for Depth Driven	Core Pumped	Measurement in Cylinder: Cyl.	Measurement in Cylinder: Dif.	Colors: Tr.	Colors: 1	Colors: 2	Colors: 3	Character of Formation	Sketch of Strata from Log
1934 May 7	15 ft.	12 in.	11 ft.	15 in.	2 in.	13 in.	13 in.	12 in.	—1 in.	1	2	0	0	River wash	.....

Date	Length of Casing	Depth Driven	Total Depth	Core After Driving	Core After Pumping	Core for Depth Driven	Core Pumped	Measurement in Cylinder: Cyl.	Measurement in Cylinder: Dif.	Colors: Tr.	Colors: 1	Colors: 2	Colors: 3	Character of Formation	Sketch of Strata from Log
May 7	15 ft.	24 in.	13 ft.	10 in.	0	8 in.	10 in.	3½ in.	—6½ in.	0	0	0	0	Sand and gravel	.....

Date	Length of Casing	Depth Driven	Total Depth	Core After Driving	Core After Pumping	Core for Depth Driven	Core Pumped	Measurement in Cylinder: Cyl.	Measurement in Cylinder: Dif.	Colors: Tr.	Colors: 1	Colors: 2	Colors: 3	Character of Formation	Sketch of Strata from Log
May 7	15 ft.	6 in.	13 ft. 6 in.	21 in.	10 in.	21 in.	11 in.	15 in.	+4 in.	0	3	1	0	Loose Gravel	.....

it was easier for them to use No. 1 as the unit color. No. 1 color is selected to weigh 1 mg. With this as a basis the following was developed:

8 fine traces equal 1 mg.
4 coarse traces equal 1 mg.
1 No. 1 color equals 1 mg.
1 No. 2 color equals 4 mg. (equals 4 No. 1's)
1 No. 3 color equals 16 mg. (equals 4 No. 2's)

This system of classification, using 4 as a multiple, is only adapted to classifying flake gold, which is generally distributed in placer deposits. Shot gold and rough gold which has no rounded edges will have to be weighed and estimated repeatedly until the operator becomes familiar with average sizes so as to construct a table from a unit system of 1 mg. as above. In classifying colors a low-power pocket magnifying glass is indispensable. High-power glasses will invariably mislead one if great care is not exercised.

In the table given it is unsafe to

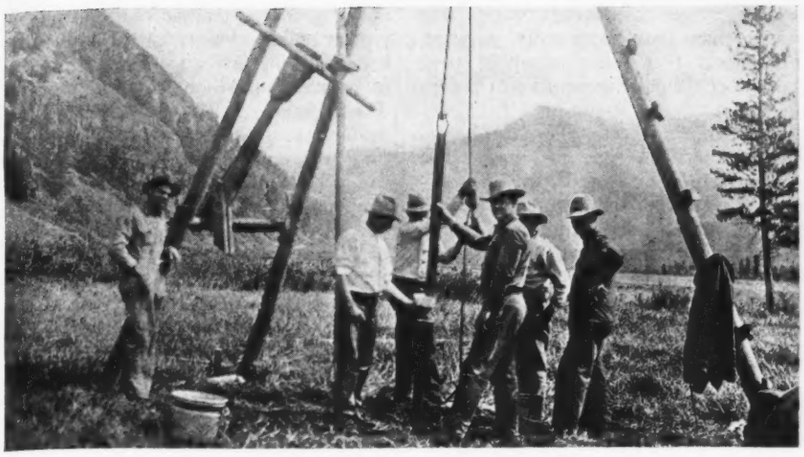
PROSPECTING SUMMARY

Property_____ Driller_____
Block_____ Drill No._____
Line No._____ Hole Started_____
Hole No._____ Hole Finished_____
Elevation_____ Panner_____

Depth in Feet	Character of Ground	Colors: Tr.	Colors: 1	Colors: 2	Colors: 3	Sketch of Strata
						Surface
	Repan					
	Sludge					
	Plug					
	Total					

Total Depth_____ ft. Depth to Bedrock_____ ft. Water Level_____ ft.
Weight of Gold_____ Mg. Fineness of Gold_____
Number of No. 1 Colors_____ Cents per Milligram_____
Average Weight per Color_____ Mg. Feet of Hole per Cu. Yd._____
Weighted Weight of Gold_____ Mg. Weighted Ratio_____
Cents per Cubic Yard_____
Cents per Cubic Yard at_____ % recovery_____

Engineer in Charge.



Hand pumping with a Ward drill. A horse can also be used where fast work is wanted

try to classify beyond the No. 3 color weighing 16 mg. Such grains and nuggets are set aside for separate weighing and estimation.

In the Drill Log in Fig. 1 a column, headed "Sketch of Strata From Log," is included. This graphic sketch is useful in that it enables one to get at a glance the relative depth of the hole, the character of formation penetrated, where the concentration of gold occurred, the character of bedrock, and the distance the hole went into the bedrock.

Fig. 2 gives an example of a subnormal hole. In this log one will note that 2 in. of core was left in the casing from previous pumping, and after driving 24 in. the core increased to only 10 in. That is to say, the increase for a drive of 2 ft. was only 8 in. instead of about 30 in. If the gravel contained considerable clay, part of the deficiency could be accounted for by assuming that some of the clay had formed a slime which could not be measured. In such cases one must use his own judgment as to the amount of core the material in the casing represents. If the gravel be ordinary, one can take it for granted that one has driven too far to obtain a normal core. In other words, the core that came into the casing during the first part of the drive formed a plug which kept more gravel from coming in. The remedy for this is to drive a shorter distance next time, or say a foot at most. This condition being known before pumping began, the latter operation was carried to the bottom of the shoe, leaving no core, so that on the next drive the gravel could enter the casing without resistance. Fortunately no colors occurred in this 24-in. drive, and therefore no weighting had to be done.

On this Empire drill, in Siberia, a special type of ram has been devised

In the case just cited, we can assume that the 10 in. of core obtained was secured in one pumping. The figures show that the actual gravel delivered by the pump corresponded to 3½ in. of core, and that in the process of pumping 6½ in. of the 10 in. which should have been pumped failed to come out. If the difference cannot be accounted for by the clay going into solution, it is evident that the pump forced some of the core out of the casing—"drove it out," as we called it. The most logical way to regulate this is to take only a few inches of core with each pumping, and to avoid driving the pump as much as possible, as well as the drill if drilling of the core be found necessary. If the hole is deep and takes much time, one might be tempted to short-cut the pumping, but if values occur in the gravel at this point, it is absolutely necessary to pump lightly to secure accuracy. With frequent pumpings the gravel does not pack behind the valve or ball, as the case might be, and more gravel enters the pump. On the other hand, if the valve or ball is held tightly against the opening by 6 or 8 in. of gravel and sand, it does not move readily and one drives some of the core out of the casing without picking it up with the pump. After all, the gravel measured in the cylinder is the gravel from which the gold is panned, and it must be closely watched if accurate results are to be had.

By carefully checking and varying both the drives and the pumpings as described, it is often possible in ordinary gravel to keep the core about normal for the depth driven, as well as the measured core as pumped out. In such cases one must use the proper factor of so many feet of hole per cubic yard of gravel when figuring the value of the hole. If this cannot be done, and no values of importance are coming in, it does not matter. However, if good values are coming in and the cores are erratic, the gold for any particular drive and pumping should be put aside in a special dish. This should also be done with each abnormal drive and pumping which shows values of importance. This gold is

Type of Empire drill employed by the author in South America over a period of twelve years (1918-1930)

weighed separately, and if the core for that particular foot or half foot driven is, say, double what it should have been, one should consider this fact for that particular drive and accept only half the gold as weighed. Conversely, if the core is too small, this also should be taken into consideration, but one should be more cautious, inasmuch as often when core is being driven out of the casing with the pump or drill, it leaves its gold behind it. Finally, in weighing the gold from the hole and estimating its value, one should compute the value per cubic yard represented by each separate dish of gold as saved in accordance with the foregoing outline, for the particular foot or more represented, and weigh these values accordingly for the length of the hole that each represents.

With a drill using a casing of 4 in. internal diameter, such refinements should not be carried too far. The main object is to regulate the driving and pumping in order to help, so far as possible, to stabilize the cores as one goes along, with the hope that the final weighting of the hole by separate weighings of the gold will not be necessary, and the customary factor can be used.

Where the colors of gold as panned from the drilling are fairly uniform in shape and weight, one can classify them in the count so as to avoid setting the gold aside for abnormal cores and weighing it separately. By counting the colors and judging their sizes under an ordinary magnifying glass, one can become surprisingly expert in maintaining certain average weights per color.

Let us consider another case, illustrated by the drill log in Fig. 3. In this instance, for a 6-in. drive 21 in. of core came in, which is far too much. In pumping, therefore, a plug of 10 in. was left in the casing. Also, in the pumping, the measured core was greater than that supposedly pumped. This means that when pumping next time one could cut the number of pumpings down.

Other contingencies also are bound to come up from time to time. If a boulder is met, or if the ground is especially tight or semi-cement, it will be necessary to drill and even pump ahead of the cutting shoe. This should be avoided if possible, but in any case it should be noted in the log.

Occasionally—say once every few days or a week—small cuttings from a wire nail should be counted and put into the hole. If the pump valve is in good order most of these should be picked up in the first pumping. If difficulty is had in recovering all of the pieces, the pump valve should be repaired.

The final weighting of the hole is an adjustment between the weight of the gold obtained and the estimated weight of the gold from a normal core. Therefore, the weighted weight of a hole must be based upon factors from normal conditions. As mentioned, we have found (1) an increase of 25 per cent between the drive measurement and the corresponding casing from the rod or cable measurement, and (2) a loss of 1 in. in 7 in. (14.28 per cent) in overflow of slime from the cylinder. These figures will serve average conditions, such as river wash and certain clay-gravel combinations where the clay content is light. Where the proportion of clay is heavy, the slime overflow ratio should be adjusted accordingly. In Table I, normal cores for various drives are indicated in the third column after making the adjustments cited.

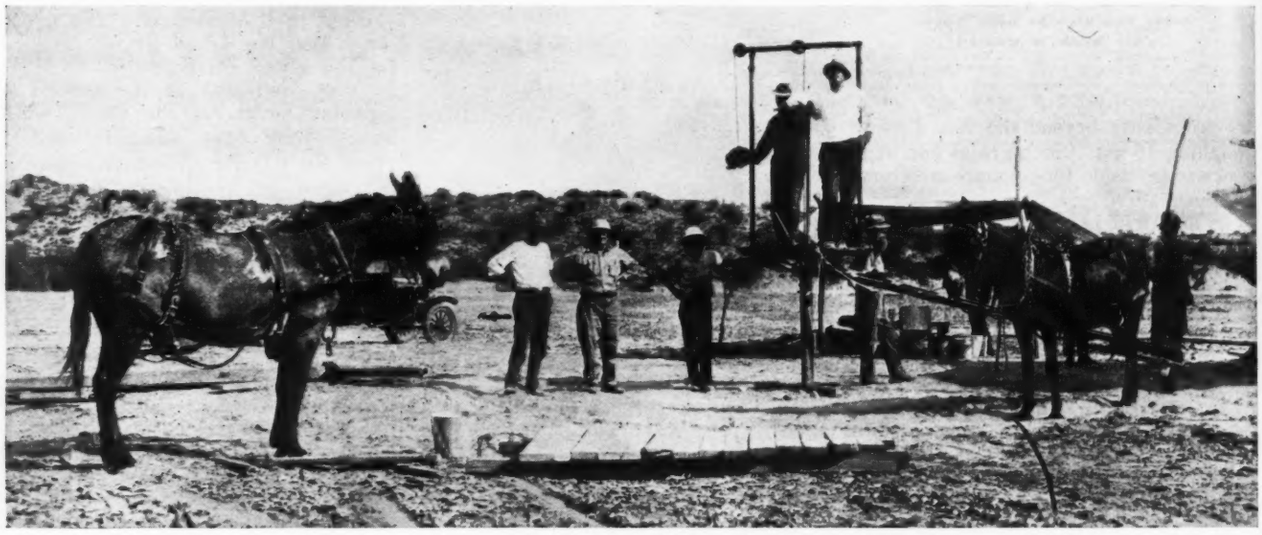
When one is able to judge the average weights of colors with fair accuracy, another set of factors (which will be explained) can be used to save time when calculating the weighted colors of a hole.

Table III will serve as a mere example of such ratio factors per color.

In all cases, it is important to have the internal diameter of the measuring cylinder the same as the internal diameter of the drill casing when using these ratio factors. Table III shows how the factors can be used for quick reference. For field use I have prepared a table of factors embracing cylinder measurements from 1 to 24 in. with the intervening half inches and drives for 1 to 36 in., which will take care of practically all field calculations.

The use of the table of factors may be explained in the following example: Let us assume that we have drilled a hole 20 ft. to bedrock, and that for 14 ft. there were no colors. The log showed colors in the remaining 5 ft. as given in Table II.

By the process of weighting we find that if the cores had been normal throughout the drilling of the hole, between 15 and 20 ft. particularly, 49.44 colors, No. 1 size, instead of 48, would have been obtained. Assuming that the 48 colors weighed 52.90 mg., there would be an average of 1.102 mg. per



Drilling gold-bearing alluvial gravel with an Empire drill in Arizona

Table I—Normal Cores for Various Drives, After Adjustments

Driven, In.	Casing Measurements (Plus 25%) In.	Less 14.28% for Slime Overflow In.
3	3.75	3.21
6	7.50	6.43
9	11.25	9.64
12	15.00	12.86
15	18.75	16.07
18	22.50	19.29
21	26.25	22.50
24	30.00	25.72

Table II—Log for 20-Ft. Hole to Bedrock

Log Data				Adjustments	
Total Depth, Ft.	Drives, In.	Cylinder Measurements, In.	Number of No. 1 Colors	Ratio Factor per Color*	Weighted Value per Color
15	12	11	1	1.17	1.17
16	12	10	1	1.29	1.29
17	12	10	10	1.29	12.90
18	12	12	20	1.07	21.40
19	12	18	10	0.71	7.10
19½	6	7½	4	0.86	3.44
20	6	6	2	1.07	2.14
			48		49.44

*These ratio factors per color are taken from Table III

Table III—Ratio Factors Per Color

Cylinder Measurement In.	Drives, Inches 3	6	9	12	18	24
2	1.61	3.21	4.82	6.43	9.64	12.86
3	1.07	2.14	3.21	4.28	6.43	8.57
4	0.80	1.61	2.41	3.21	4.82	6.43
5	0.64	1.29	1.93	2.57	3.86	5.14
6	0.54	1.07	1.61	2.14	3.21	4.28
7	0.46	0.92	1.38	1.84	2.76	3.68
8	0.40	0.80	1.21	1.61	2.41	3.22
9	0.36	0.71	1.07	1.43	2.14	2.86
10	0.32	0.64	0.96	1.29	1.93	2.58
11	0.29	0.58	0.88	1.17	1.75	2.34
12	0.27	0.54	0.80	1.07	1.61	2.14
13	0.25	0.49	0.74	0.99	1.48	1.98
14	0.23	0.46	0.69	0.92	1.38	1.84
15	0.21	0.43	0.64	0.86	1.29	1.72
16	0.20	0.40	0.60	0.80	1.20	1.60
17	0.19	0.38	0.57	0.76	1.13	1.52
18	0.18	0.36	0.54	0.71	1.07	1.42
19	0.17	0.34	0.51	0.68	1.02	1.36
20	0.16	0.32	0.48	0.64	0.96	1.28
21	0.15	0.31	0.46	0.61	0.92	1.22
22	0.15	0.29	0.44	0.58	0.88	1.16
23	0.14	0.28	0.42	0.56	0.84	1.12
24	0.13	0.27	0.40	0.54	0.80	1.07

color. Multiplying the 49.44 weighted colors by 1.102, we have 54.48 weighted milligrams. Dividing 54.48 by 52.90 there is a weighted increase ratio of 1.03.

Evidently, this method of weighting a drill hole will introduce plus or minus errors into the calculations unless great care is used in classifying the colors and then reducing them to the unit color before adjusting.

After a hole has been weighted and all calculations as to its value are completed, these facts and all essential log data may be recorded on a form, such as the so-called Prospecting Summary, shown on p. 294.

The Drill Log, previously referred to, requires a stiff cardboard binder, provided with rings, and a waterproof back. A dozen or more of the forms can be placed in the binder at a time. A thin carrying case for the binder, with room for pencils, erasers and time book, is useful.

Although perfection is not claimed for this method of core control, it is in advance of anything that has come to my attention during a drilling experience of about 24 years. The system will work provided a sufficient number of holes have been systematically drilled on a tract so that the law of averages may be employed in computing the values. As I have added refinements to the general idea, so may others.

Drill equipment, both hand and power-driven, calls for improvement, if it is to work to the best advantage with this method. Drill runners must be educated up to it. Runners must be absolutely honest, as well as intelligent and resourceful. They must be honest in recording the data, no matter whether it seems inconsistent or otherwise, and vary the technique as conditions down the pipe may demand, even to a radical variance if necessary. An honest record on the log is required by the engineer in charge, so that he may be able to interpret it clearly, and an intelligent application of the method with the equipment.

All of this boils down to the simple, yet difficult, operation of obtaining from the extracted core the gravel that the drive calls for. So many conditions down in the pipe tend to complicate this operation that the engineer is kept on his toes to anticipate them and to control them when they appear, and to weight the record from the log so that the results may represent normal values per cubic yard.

Gold Transport by Air

Loads on Africa and India Routes Increasing

THE increasing transport of bullion by aircraft, rather than by ship and train, provides an interesting feature in the operation of such a long-distance air service as that of Imperial Airways between England and South Africa.

Consignments of bullion for London, if sent by surface transport from mines in the interior of Africa, have first of all to go by rail or other means to one of the ports along the coast, and then continue their journey to England by sea; the result being a total transit time of perhaps 30 or 40 days. But when air transport is utilized, the gold has only to be taken from the mines to one of the adjacent air-stations; after which it is flown at such speed to London that it reaches its destination within a week of its being handed to the airway officials in the heart of Africa.

Various methods are employed in packing the gold for air transport, but in the majority of cases it is consigned in the usual wooden boxes, with steel bands and seals.

The advantages of being able to save approximately three weeks on the transport of a load of bullion from the mines to London are too obvious to need emphasis. Naturally consignors have to pay for the speed of air dispatch, but they are perfectly willing to do this, bearing in mind the fact that the sooner the gold is placed on the market the sooner it becomes interest bearing. The use of the air route, as contrasted with surface transport, has also the added advantage that insurance rates are, as a rule, very considerably lower for air-borne gold than they would be if consignments went by ship and train.

It is difficult to quote cases which are typical, as conditions vary considerably, some mines being in a better position than others, owing to their locality, to take advantage of the facilities which air transport offers. But, taking the instance of mines in Africa which are well situated so far as air transport is concerned, but which have to consign gold for some distance by rail to a coastal port, before it can be put on board a steamer for London, one often finds it actually cheaper to consign a load by airway—taking all factors into consideration—than it would be to send it by boat and train. This is largely due, when weeks are saved by air, to the reduction of the interest charges incurred when bullion is in course of transit. Considerable savings are also effected under the heading of insurance, and these economics more than offset the express charges for air dispatch.

This being so, it is not surprising that gold consignments by air should be on the increase. This form of traffic is, however, still in its infancy. Many mines have been making experimental consignments, checking up carefully the results they have obtained. Others, so far, have been using the air only occasionally, when special circumstances have arisen which have suggested such a course. But the arguments in favor of air transport are usually so convincing, both economically and from the viewpoint of convenience, that the disposition now is to make an appreciably greater use of it. Reckoning both the Indian and African routes of Imperial Airways, and taking a period of two months early in 1934, and comparing these with a similar period in 1933, the amount of gold air-borne is seen to have increased by more than 60 per cent, and no doubt is felt that, with facilities developing for handling this form of traffic, it will continue to expand.

Cyaniding Makes Progress

Rand Research Indicates That Oxygenation of Solutions Under Pressure Will Increase Gold Recovery And Reduce NaCN Consumption

THAT the presence of oxygen is of benefit in the dissolution of gold by cyanide solutions has been known for years. An interesting study of this problem, with a practical method of increasing the oxygen content of cyanide solutions, is presented in an article by T. K. Prentice, in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa. The following is an abstract:

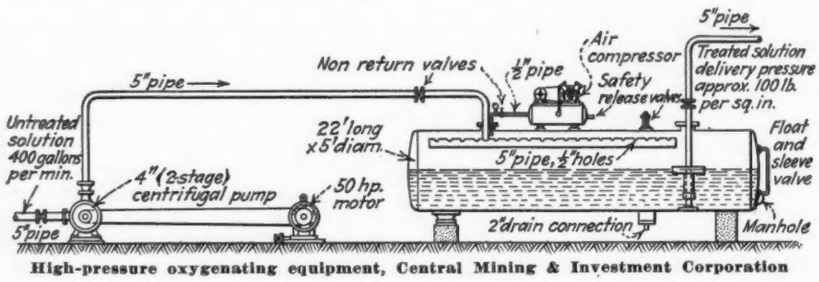
The usually accepted reaction is $4\ Au + 8KCN + 2O + 2H_2O = 4KAu(CN)_2 + 4KOH$, according to which 521 parts of KCN require 32 parts of oxygen for the satisfactory dissolution of gold. Thus a solution with 0.05 per cent KCN should contain 30.7 mg. of oxygen per liter for maximum dissolving efficiency, and a 0.02 per cent solution, such as used at Modderfontein East, should contain 12.3 mg. per liter. One reason for the apparent lack of interest in this problem is, that prior to 1918, when H. A. White introduced his method for determining the oxygen in cyanide solution, based on the color imparted to alkaline pyrogallol, a detailed knowledge of the oxygen content of all solutions in circuits had been difficult to acquire.

At the altitude of the Rand, with a normal barometric pressure of 620 mm., about 7 mg. of oxygen should dissolve in a liter of water at 15 deg. C., on exposure to the atmosphere. Assuming that cyanide solutions would dissolve about the same quantity, one may expect at least 6 mg. of oxygen in the solutions on the Witwatersrand. Although in exceptional cases some solutions do come up to this figure, many show a considerable deficiency in oxygen, and one of the problems associated with the dissolving of gold is to account for this deficiency, and to find a remedy therefor. In the Central Mining-Rand Mines group the oxygen content varies from 2.5 to 5.5 mg., with the average below 4 mg.

Here the questions naturally arise: Why do not these solutions, so freely exposed to the atmosphere, carry any more oxygen, and by what means can their oxygen content be increased? This problem became acute at the Nourse mine in 1931, when the oxygen content dropped to 1 mg., with a corresponding long sequence of high residues. Undoubtedly the principal cause for this deficiency may be traced to reducing matter in the ore and in the mine water. Here it should be noted that the deficiency is the greatest in those mines where neutralized mine water is the chief supply for mill water, particularly if the settlement area after neutralization is limited. Several methods for raising the oxygen content may here be mentioned, such as the generation of nascent oxygen in the solution by electrolysis, the addition of oxidizing agents, or the use of atmospheric oxygen.

According to Henry's law, the weight of a gas absorbed by a given volume of liquid is directly proportional to the pressure of the gas. If at one atmosphere 6 mg. of oxygen is absorbed, at five atmospheres this figure would be 30 mg., which, as previously stated, is the theoretical quantity required to give maximum efficiency with a solution containing 0.05 per cent KCN. Obviously, when the pressure is released, the oxygen content again diminishes, but no matter how great the deficiency before the pressure is applied, it may be assumed that the excess oxygen, while under pressure, destroys the reducing matter present, so that on reversion to atmospheric pressure the oxygen will not again fall below 6 mg.

To test the correctness of these deductions a large quantity of solution at the Nourse mine, containing 2.5 mg. of oxygen, was subjected to various kinds of treatment to raise the oxygen content. A review of these laboratory tests indicated that little improvement was obtained by bubbling compressed air through the solution at atmospheric pressure. Introduction of air by a mechanical mixer increased the dissolved oxygen to a maximum of 5 mg., with a consequent acceleration in dissolving, but such intimate contact between air and solution is hardly economical on a large scale, on account of high consumption of power and cyanide. Addition of pure oxygen gas is also too costly. Keeping the solution in contact with compressed air for 20 min. gave a solution saturated with oxygen, of a high dissolving efficiency.



High-pressure oxygenating equipment, Central Mining & Investment Corporation

As the latter procedure was considered sufficiently attractive to justify further investigation, a small semi-commercial unit was put into operation, in which the solution was passed through a cylinder of 3 ft. diameter and 5.17 ft. long, the capacity of which when half full was 0.42 tons, with an exposed solution area of 15.5 sq.ft. Solution was fed through a pipe with 20 ½-in. holes, placed in a row to throw the solution upward, as shown in the illustration. Compressed air was added at the top through a ½-in. pipe, and a 2-in. discharge pipe was placed at the bottom. Several tests were made with an air pressure averaging 65 lb. Initial oxygen content was 3.5 mg., that of the discharge 6.5 mg., with a rate of flow of 0.42 ton per min., the solution remaining in the cylinder 1 min.

Upon discharge the solution was milky white from dispersed air, but it cleared after about one minute's standing; oxygen tests were made on the clear solution. Air consumption was negligible, less than 2 cu.ft. of free air per min., and cyanide consumption was likewise negligible. A slight escape of air from the cylinder was found desirable to prevent concentration of nitrogen. Solution having 6 mg. of oxygen, when left in an open bucket, showed 5 mg. after 1 hr., 4.5 mg. after 5 hr., and 4 mg. after 22 hr. Left in the cylinder 16 hr. with 100-lb. pressure the solution showed 7 mg. upon release.

These results prove conclusively that the oxygen content of mill solutions may be materially improved by this simple, continuous process. The next step in the investigation was to ascertain what benefit would be derived by treating ore on a large scale with such a solution. An acceleration in the dissolution of gold was expected, especially the absence of periods of erratic results such as experienced in nearly all cyanide plants, although no appreciable improvement over normally good residues was looked for. Some reduction in cyanide consumption was also anticipated. Six 410-ton sand charges were treated, three in normal manner and three with aerated solution; with the equipment available it was not possible to use more than an average of 36 per cent of aerated solution on the latter. Final residues in aerated treatment assayed 0.340, 0.330, and 0.335 dwt. gold per ton, compared with 0.350, 0.375, and 0.345 dwt. for the normal charges. The most remarkable result was perhaps the pronounced reduction in cyanide consumption, an average of 49.4 lb. NaCN for the aerated solution against 75 lb. for the normal treatment.

The Polarograph

A Valuable Tool in Quantitative Chemical Analysis

John Herman
Assayer and Chemist
Los Angeles, Calif.

● SIXTY-FIVE ELEMENTS *have thus far been determined successfully with this instrument. So sensitive is it that a concentration of only one part in a million can be easily detected. The scope of its possible application is wide, including the determination of impurities in "pure" metals and of the solubility of so-called insoluble compounds, as well as the separation of mixtures of closely related elements. During the past year, the author worked at Charles University in Prague, Czechoslovakia, with the inventor, Dr. Heyrovsky, of that institution, to devise a method of analysis for gold with its use. The attainment of the objective is described in this article.*

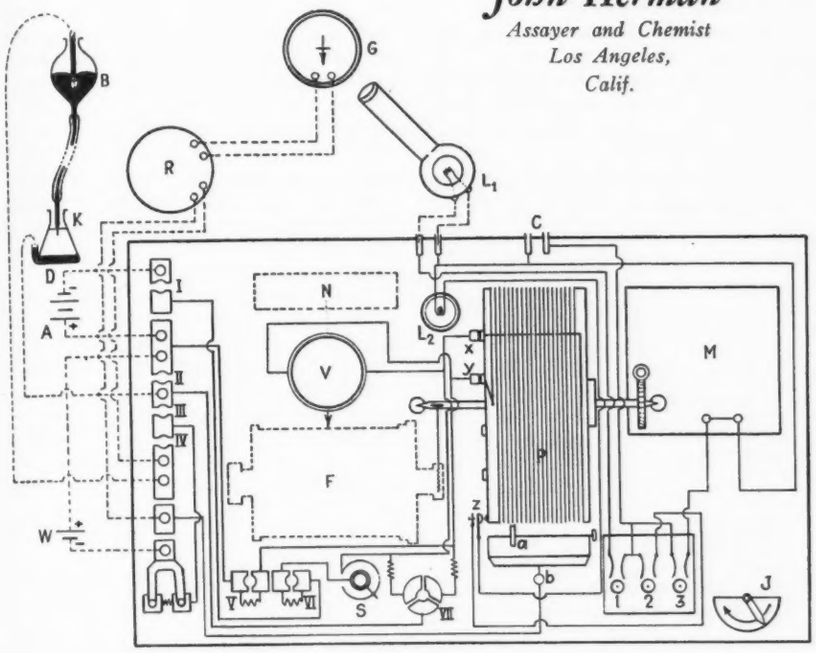


FIG. 1—SCHEMATIC DIAGRAM OF THE POLAROGRAPH

A Accumulator
B Mercury reservoir
C Connection to mains current
D Mercury anode
F Photographic cylinder
G Galvanometer
J Motor regulator
K Mercury cathode
L_1 Galvanometer lamp
L_2 Lamp marking abscissae
M Electric motor
N Mirror to show scale
P Potentiometric wire
R Reductor (Ayrton-shunt)
S Sliding wire for E.M.F. regulation
W Weston cell
X, Y Contacts to the potentiometric wire
Z Contact to lamp for abscissae
a Trolley contact
b Screw to lift trolley

Plug contacts to connect:
I. Accumulator
II. Electrolysis
III. Anode-potential measurement
IV. Balancing of E.M.F. by Weston cell
V. 16 Ohms before the potentiometric wire
VI. 16 Ohms after the potentiometric wire
VII. For anodic and cathodic polarization
1 Switch for L_1, *2* Switch for L_2, *3* Switch for *M*

IN the Polarograph, an instrument invented and developed by Dr. J. Heyrovsky, professor at the Charles University of Prague, Czechoslovakia, an apparatus has been made available for detailed study of electrolytic processes by current-voltage curves. In combination with the dropping mercury cathode cell it offers a method for the solution of many problems in analytical and physical chemistry, and opens up entirely new fields for practical research work.

The two factors upon which the method is based are the difference in decomposition voltage of the various chemical compounds, and the direct relation between electrical effect and the concentration of a compound in a solution. To analyze a solution a current is passed through it, while the voltage is gradually increased from zero to 4 volts. As the decomposition voltage of any compound present in the solution is reached this is indicated by a sudden abrupt increase in the magnitude of the current which continues until a certain value has been attained, a value which is a function of the concentration of the compound involved. The voltage at which the decomposition starts gives the qualitative indication of a certain compound, while the increase in the current, measured by a recording mirror galvanomter and conveniently registered as a curve, gives the concentration. A curve giving the variations in the current, the so-called waves, is reproduced in Fig. 2.

After completion of the decomposition, the curve again becomes horizontal until the decomposition voltage of a second compound has been reached, when the curve again rises sharply. Thus it continues, each individual compound causing a rise at its specific decomposition voltage, without any interference by the others. By suitable grouping of compounds, the decomposition voltages of which vary sufficiently, qualitative and quantitative tests may be made on a solution containing as many as half a dozen different compounds.

Where the decomposition voltages of certain compounds lie very close together, separation may be made possible by addition of complex ions to the solution. The method has been used successfully for about 65 of the existing 92 elements. By differing means of approach the majority, if not all, of the remaining elements may be determined.

The sensitivity of the method is so great that elements are easily detected in concentrations of one part in one million, and far greater dilutions are often within its scope. Only a very small sample is required, from 0.1 to 0.2 c.c., and with specially designed equipment samples of only 0.01 c.c. have been used. The method is quick, accurate, and involves no loss of material; it may also be used as a macro-method. An important point is that the analyses of a solution may be repeated indefinitely

without altering the solution and without any change in the curve in the different determinations.

A diagram of the apparatus used is presented in Fig. 1. At the bottom of a reaction vessel is a layer of mercury which serves as anode, while a dropping mercury cathode is used, from which drops of mercury enter the solution at regular intervals of 2 to 3 sec., through an immersed capillary tube. The voltage between the electrodes is increased automatically by the movement of a sliding contact along a resistance wire; this wire is wound in 20 turns on a drum of non-conductive material and connected to the poles of a 2- or a 4-volt battery. The drum is turned by an electric motor, each turn giving an increase in the voltage of 100 or 200 millivolts, according as a 2- or a 4-volt battery is used. By means of a sensitve mirror galvanometer (10^{-8} to 3×10^{-9} amp./mm./m.) the current is recorded as a curve on a moving strip of photo-sensitive paper. A specially designed reductor is used to divert any desired portion of the electrolytic current through the galvanometer. A curve is completed in from 3 to 5 min.

No undesirable secondary effects can interfere in the method, as only the reaction at the cathode, the surface of which is constantly renewed, is studied. As the hydrogen over-voltage has its maximum with a fresh mercury surface, the evolution of hydrogen does not interfere in the examination of an aqueous solution; acid solutions may therefore be analyzed equally well as neutral and alkaline solutions. No change takes place in the anode potential during the electrolysis.

The interpretation of the current variations, or waves, may be seen from Fig. 2, in which the abscissae give the applied voltage, and the ordinates the intensity of the current. From this we see that the intensity of the current suddenly increases at 0.45 volts, signifying that an electrochemical reaction has set in. At 0.75 volts another reaction starts, a third at 1.10 volts, and finally a fourth at 1.50 volts. Tabulated data have shown that with the dropping mercury cathode these values correspond to the decomposition voltages for lead, fumaric acid, zinc, and hydrogen, respectively.

From the height of the wave the concentration of these compounds in the sample may then be calculated. If, for instance, a galvanometer at its full sensitivity gives a wave 5 cm. high for a certain element in a concentration of 0.0001 N, then a wave 2 cm. high, with the galvanometer set at 1/250 of its full sensitivity, would correspond to a concentration of $0.0001 \times 2/5 \times 250 = 0.010$ N.

Among the applications of the method may be mentioned the analysis of impurities in pure metals, such as high-grade copper and zinc; the determination of the various alloying constituents in complex alloys, of alkaline earths in radium salts, of columbium in tantalum; separation of mixtures of closely related elements such as vanadium, tantalum, and columbium, the alkali metals, and the halogens; determination of the solubility of so-called insoluble compounds, such as barium sulphate; qualitative and quantitative analysis of rocks, minerals, and ores; and control of the purity of reagents. It is also a valuable tool in the study of adsorption, catalysis, diffusion, and many other chemical and physical phenomena.

Until recently it was thought that gold, being nobler than mercury, could not be determined by this method. The only possible way to attain this would

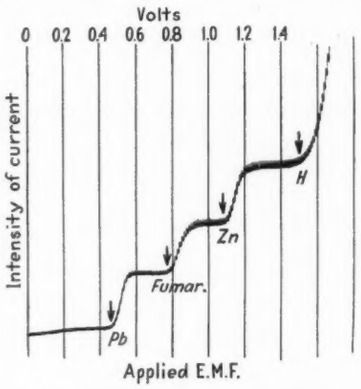


Fig. 2—Polarogram of a solution containing 0.005 mol. $PbCl_2$, 0.005 mol. fumaric acid, 0.005 mol. $ZnCl_2$ in 0.016 mol. HCl. Sensitivity of the galvanometer 1:250

be to find a suitable complex of gold, much more stable than the corresponding mercury complex, from which gold will not be deposited on mercury electrodes without the application of an external electromotive force. Unfortunately, nearly all complex compounds of gold are similar to those of mercury, and gold will therefore generally be precipitated on the latter metal.

A short time ago I undertook the investigation of a number of such complex compounds, of which the cyanide solutions were found to be the most suitable for analytical purposes, although the alkali hydroxide complexes were the first to give satisfactory curves. Both auric and aurous hydroxides dissolve in alkaline solutions readily enough to form solutions which may conveniently be tested for gold polarographically.

There are two distinct cyanide complexes of gold, the trivalent and the mono-valent gold cyanides. In this investigation the tri-valent complexes were prepared from solutions of trivalent gold ($HAuCl_4$ and $NaAuCl_4$) added to excess of potassium cyanide or other soluble cyanides.

To determine gold in ores, bullion, and other products the gold is first dissolved in iodine, cyanide, aqua regia, or chlorine, and a suitable solution is then prepared to which could be added cyanide, alkali hydroxide, or a mixture of both. Zinc, copper, and iron do not show polarographically in a high concentration of cyanide, while silver, arsenic, lead, and bismuth do not interfere. If desired, gold may first be precipitated from the solution on metallic zinc and separated in a suitable manner prior to the preparation of the solution for the polarographic determination.

The outstanding phenomenon encountered in the investigation was probably the extreme steadiness of these gold complexes, chiefly the tri-valent gold in the mixture of alkali hydroxide and cyanide, and in cyanide alone. If once formed by the addition of auric chloride either to an excess of alkali hydroxide or of alkali cyanide no interchange takes place in the presence of other complex-forming salts. The stability of auric complexes in hydroxide or cyanide is also shown by the fact that they are not reduced by sodium thiosulphate.

It has been found that auric complexes are always accompanied by aurous complexes, into which they slowly decompose, but are in no mobile equilibrium. Auric cyanide complexes show the peculiarity that they are reducible at a lower voltage, the difference being 0.7 volts. For the auric complexes the wave starts at 0.4 volts, and for the aurous compounds we consequently have a wave starting at 1.1 volts.

Gold complexes do not show any pronounced change toward equilibrium when excess of alkali cyanide or hydroxide is added, but appear very stable when once formed. They furthermore always remain electrolytically reducible, no matter what excess of complex forming anions may be present.

The Tchisa Stick

Rand igniters, or tchisa sticks, are commonly used in South Africa to ignite fuses. The present-day tchisa stick is regularly supplied by the powder companies. It consists of a stiff glazed paper tube, $\frac{1}{4}$ in. in diameter and 8 in. long and having a short wooden handle, the tube containing a mixture of combustibles and oxidizing agents proportioned to give on ignition a strong pointed flame of good igniting power; the only way to extinguish one is to cut off the burning end. It takes about four minutes for one to burn completely. As it was used on one small job, the foreman would gather all the fuse ends in one hand and cut off the damp tips. His boy would then light the tchisa stick with a match, pass it to him, and he would spit all the fuses surely and so quickly that one stick was sufficient for four to six rounds as a rule—so quickly that a witness doubts if anyone who had ever used these igniters would ever afterward be content to ignite fuse in any other way.

Depression Developments In Fluorspar Milling

Hard times and a falling market caused one Illinois operator to adopt double jigging, thereby permitting him to make a high-grade concentrate and a low tailing, a combination previously unattained in the district

E. C. Reeder

Superintendent, Hillside Fluor Spar Mines, Rosiclare, Ill.

IF THE DEPRESSION had not come, it is likely that the plant extension here described would not have been built and we would still have been speculating as to what we might be able to do, were we provided with the necessary equipment.

In milling fluorspar by wet gravity methods, the limits to what can be done on a jig are narrow. The market demands a high-grade concentrate, and to make such a concentrate requires a high-grade jig feed, as a concentration ratio of about 1½ to 1 is about all that can be expected of a single jigging, where the product is finished in one operation. This means that, in addition to requiring a high-grade feed, a low-grade tailing cannot be expected, so that the best that can be achieved is a compromise. During 1928, experimental work showed that it would be feasible to rejig the tailings from our spar jigs, thereby producing a low tailing that could be discarded, and a concentrate about equal in grade to the crude-ore feed that was going to the spar jigs.

Accordingly, a small addition to the mill plant was made, of sufficient capacity to handle the tailings as produced by the spar jigs. This unit, installed in the mill building, consisted of a 25-ft. Hancock jig, a small pair of rolls, a screen, and necessary elevators to handle the products. The coarse tailings were given a light crushing to release locked mineral, and were then treated without sizing over the Hancock jig. The latter handled an average feed containing 20 to 24 per cent CaF_2, and produced a concentrate averaging about 58 per cent CaF_2, and a 9 per cent tailing, about half of the spar content of which was locked mineral. One man handled the tailing plant, which produced the equivalent of 5 to 7 tons of gravel spar concentrate daily.

All the jig tailings produced by the mill prior to the starting of the tailing plant were stacked up outside the mill, awaiting the time when they could be re-worked and the spar they contained be recovered and marketed.

Upon the experience gained by the operation of this Hancock jig on re-jigging tailings was based the decision by the company late in 1930 to build at once a plant large enough to re-work the accumulated piles of jig tailings stacked up below the mill. The spar market was shrinking rapidly, and prices had dropped to a level below which spar could be profitably produced by ordinary methods, but at which, nevertheless, it could be produced from tailings cheap enough to allow the company to carry on in a very limited way. Designing of this tailing plant was conducted with the idea that the jig equipment would be used to handle crude ore upon the exhaustion of the supply of tailings. Work on the reclamation plant, as we called it, was started soon after the beginning of 1931, and the plant was put into commission late in June of that year.

Mining work underground came to an end during the summer of 1931, and was not resumed until June, 1933, the tailing plant supplying the tonnage of marketable spar produced in the latter part of 1931, the entire year of 1932, and the year 1933 up to July, which saw the clean-up of the tailing piles. The jigs in the old mill were operated as finishers during the time the tailings were being run through the reclamation plant, and few alterations were necessary to adapt them to this work, the principal changes being in the screen sizes. As the old mill was equipped with a picking belt, a jaw crusher, and rolls, this machinery was all idle while we were reclaiming tailings.

As the end of the tailing campaign approached we began to get the mill ready to run on ore from the mine. The crushing machinery was rearranged and the trommel screens were discarded in favor of Leahy vibrators during the summer of 1933. A study of the flowsheet, accompanying this article, will show that we had to insert the rougher jig operation in ahead of the feed bin in the old mill. The jaw crusher was raised 6 ft. and the primary rolls were raised 20 ft., which made room for a scalping screen below, so that the oversize could be fed to the secondary rolls, and all the feed finally reached a belt conveyor, which carried the crushed ore into the feed bins supplying the rougher jigs. In former days, when the mine ore was treated and finished in one jigging operation, our largest size of particle was ⅝ in., but under the new arrangement our largest size is ½ in. Also, under the old arrangement, all of the mine ore was hand-sorted, waste and low-grade material being discarded by pickers on the belt in an effort to bring up the spar content of the jig feed to 50 per cent or better. From eight to ten pickers were always employed on the belt, and unless a piece of ore was at least one-third spar it had to be discarded and sent to the waste dump.

Under the new arrangement but three or four pickers are needed. Only clean waste is discarded. Everything con-

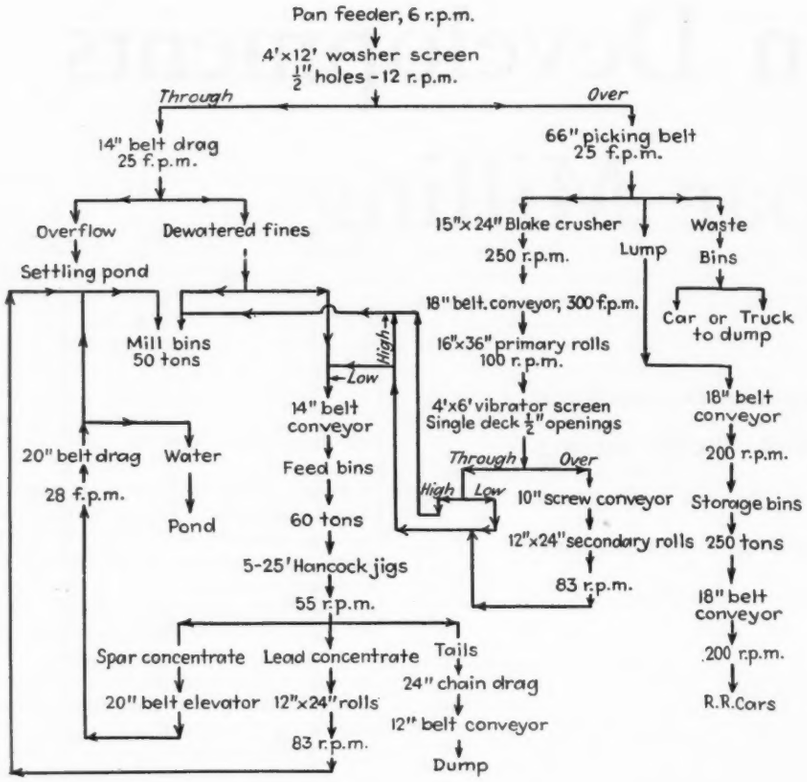


Fig. 1—Flowsheet of sorting, crushing and roughing section, Hillside fluorspar mill. The position of the newly installed roughing jigs is shown. A bin precedes the pan feeder

taining any spar is regarded as ore, and remains on the belt and goes to the crusher.

The Hancock jigs are in the new part of the plant, in a steel building located alongside of the old mill building, and 10 ft. from it. The floor level of the new building is the same as that of the lower floor of the main mill, and covered ways are provided for passage between buildings. The new structure is 50x40 ft. in plan, with side walls 16 ft. high over the jigs and 22 ft. high over the bins. The span of the roof trusses is 50 ft., leaving the entire floor clear of posts. A ventilating skylight, 5x20 ft., provides light and in warm weather aids ventilation. The building was designed and fabricated by the Stefco Steel Company, Michigan City, Ind. Erection work was done by the mining company.

Ore bins are of ordinary wood construction and support the belt conveyor bringing the crushed ore from the crushing plant in the old building. A fixed tripper fills the bin spanned by the conveyor.

The Hancock jigs are of standard Allis-Chalmers design, with wood hutches and trays.

Tailings are dewatered by a 24-in. drag built in as a part of each jig, and driven by belt and gears from the line-shaft driving the jigs.

Instead of mounting the jig hutch box on the usual cast-iron legs, concrete walls were used, with results that have been satisfactory to date. The jigs are arranged side by side in pairs, right and left, with the concentrate spigots of each pair discharging into a common launder. An exception is the fifth jig, which was moved from the old mill building several years later to a place alongside the other four machines, and put in a space reserved for it. Four jigs are usually operated at one time, the fifth being a spare, which can be started whenever a jig must be stopped for cleaning sieve or for repairs.

As the run-of-mine ore feed carries considerable lead in the form of galena, most of the coarse lead is recovered as a bed concentrate, which is removed from the jig by skimming. The reason for handling the lead in this manner is that the coarse concentrate must be

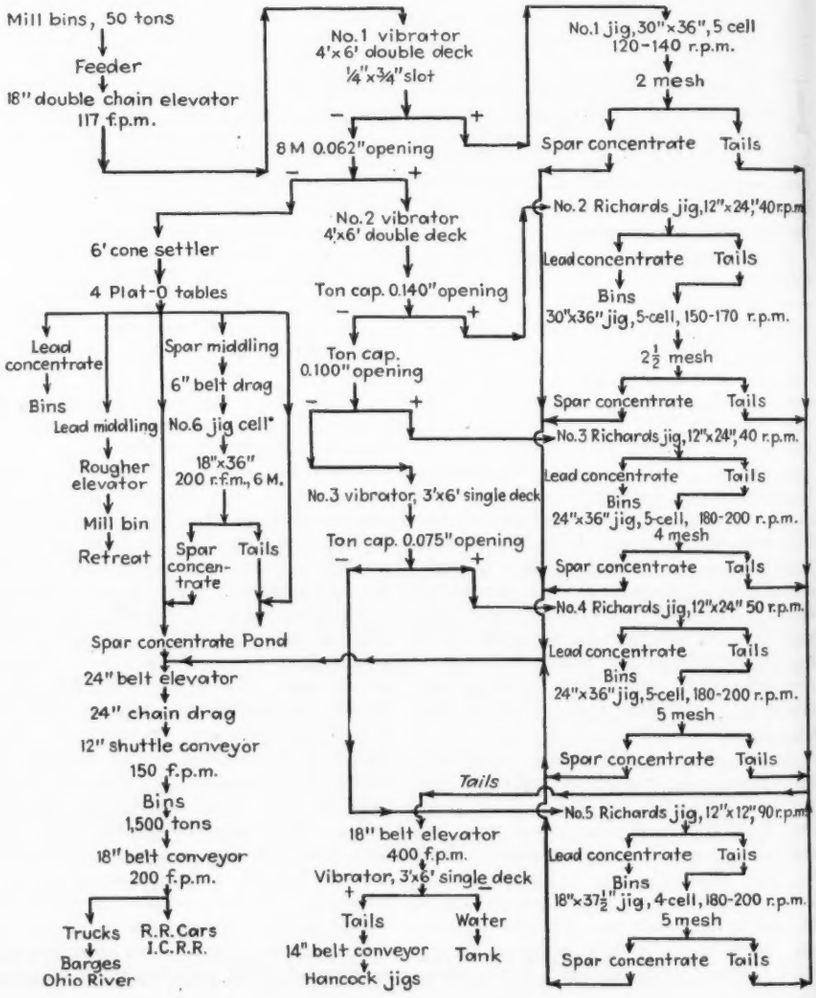
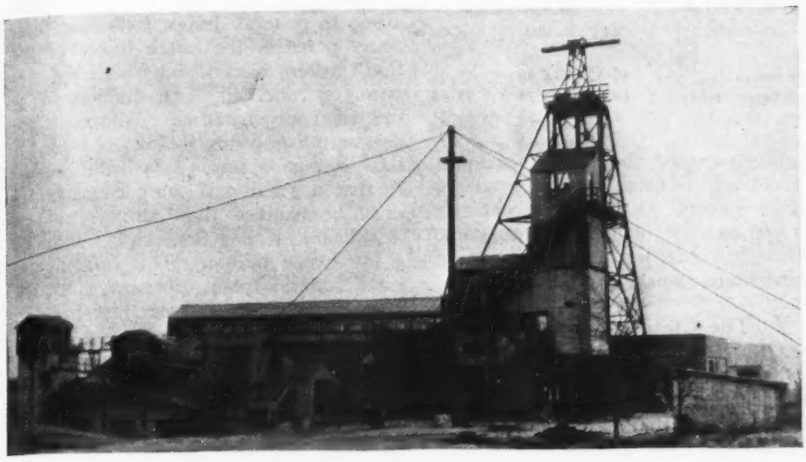
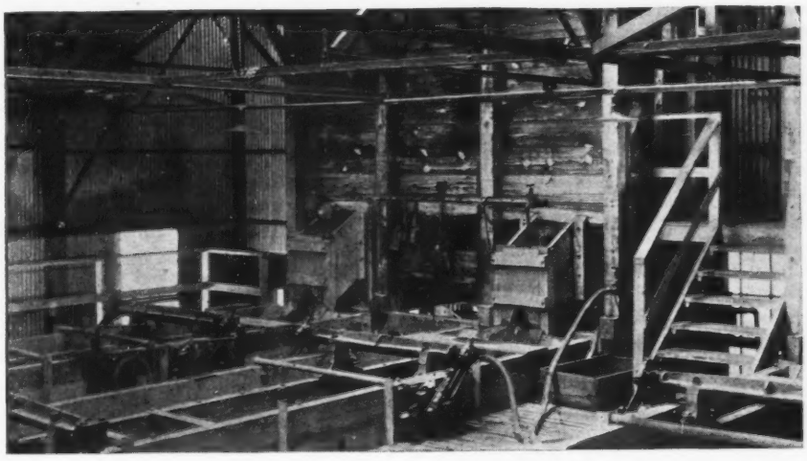


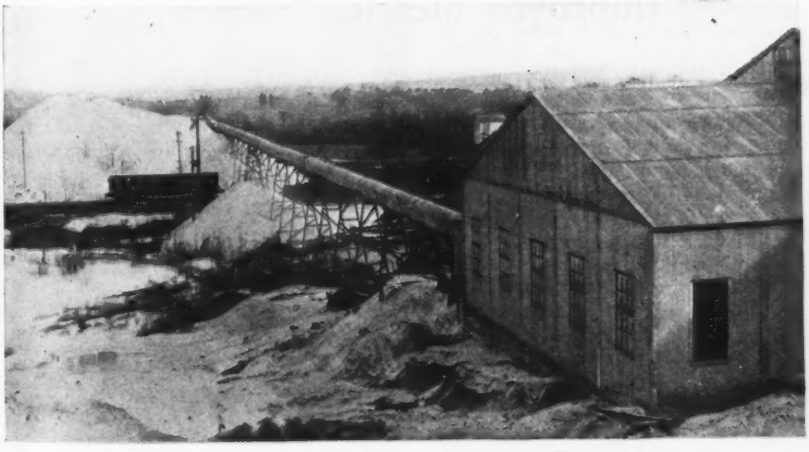
Fig. 2—Flowsheet of sizing and finishing section



Shaft and mill of Hillside Fluor Spar Mines, Rosiclare, Ill.



Inside the mill. Two of the Hancock jigs



New addition to the mill. Tailings dump on the left

re-crushed to free the lead from fluorspar. Lead concentrate containing very much fluorspar is objectionable to the operators of the lead smelter, as the rabbles in their Scotch hearth furnaces are destroyed rapidly by the fluorite. The sieves on these jigs are of woven steel wire, and are 32½ in. wide by 225 in. long and divided into sections of different size mesh, the sizes used being as follows, beginning at the feed end:

37½ in.	3 mesh	0.120 wire	0.213-in. opening
37½ in.	2½ mesh	0.135 wire	0.265-in. opening
132 in.	2 mesh	0.135 wire	0.365-in. opening
18 in.	½ c. c.	0.244 wire	0.500-in. opening

As there is so much mineral in the jig feed that it cannot all be passed through the sieves into the hutch before it reaches the tail board, we fitted draw-off wells to the sieves of these jigs. These draw-offs are attached to the sieve about 7 ft. from the tail end, and the bed is drawn through into the hutch, each jig having two draw-offs mounted side by side about a foot apart. They consist of a piece of ¼-in. steel plate 5-in. square with a 1½-in. hole in the center, to which is welded a piece of 1½-in. steel pipe 8-in. long. This pipe, at the bottom where welded to the plate, is cut away about ¾-in. high for half the circumference, this slot forming the passage for the concentrate to the hutch. The plate is bolted to the screen over a hole which matches the hole in the plate, and over the 1½-in. pipe is slipped a piece of 2-in. steel pipe 12 in. long, also with a circular slot cut on the bottom end. When the 2-in. pipe is turned so that the two slots correspond, the draw-off is open and, by turning the pipe mentioned, any opening from full to closed can be had at will. As the 2-in. pipe projects above the water level, a piece of ½-in. rod passed through holes in the pipe makes a convenient handle for turning.

All five Hancock jigs are driven from a lineshaft at the tail end by a 20-hp. 860-r.p.m. motor belted to this shaft.

Tailings, after being dewatered by the drag on each jig, drop upon a 12-in. belt conveyor which runs to the tailing dump. This conveyor is 456 ft. 7 in. center to center, with a 6-in. steel channel frame supported on 4x6 in. timber bents. The rollers all have ball bearings, and a 10-hp. 1,160-r.p.m. motor furnishes power to drive the belt at a speed of 200 r.p.m. This conveyor discharges upon a swivel section 60 ft. long, which can be moved radially as the pile of tailings grows, and is shortened or lengthened by taking out or adding 16-ft. frame sections.

Rougher concentrates are sluiced in launders to the rougher elevator, which raises them high enough to reach the dewatering drag, from which they drop to the mill bin. The rougher elevator is a concrete structure built to the following dimensions: Boot 7 ft. 4 in. long by 8 ft. wide and 8 ft. deep; housing 3 ft. 7½ in. by 7 ft. 6 in. inside by

40 ft. high, with 6-in. walls re-enforced with ⅝-in. steel bars. This elevator is 46 ft. 0 in. center to center, with 30x22-in. pulleys, 20-in. by 8-ply rubber belt, and 20-in. buckets, and it runs at a speed of 355 ft. per min. The motor is 15 hp., 860 r.p.m., connected to the head pulley by gears and a V-belt drive.

When designing the plant, we intended to build this elevator of wood, but found that for very little additional cost it could be made of concrete. As the life of wood construction is short, we felt that we were justified in adopting the more permanent type. The boot was built in the ordinary way, but for concreting the housing we used collapsible forms in 4-ft. sections, pouring a section a day. Four sections were used, the one stripped from the bottom being placed on top. Concrete was hoisted in a tub made from a 30-gal. oil drum, the tub passing up inside the housing, thus avoiding the necessity of outside scaffolding. A sheave block supported by an "A" frame made of steel pipe, resting on the eaves of the concrete mill building, with steel guy ropes holding it erect, was high enough to take care of the hoisting requirements from start to finish. A 7x10 double-cylinder, double-drum, contractor's hoist, placed on the ground and operated with compressed air, hoisted the concrete and handled forms and re-enforcing. A wood house over the top of the elevator encloses the motor and drive gearing.

Dewatering

As the rough concentrates must be dewatered before reaching the mill bin, they are sluiced to a Pachuca-type drag belt dewaterer. This drag has a capacity of 20 tons of dewatered concentrate per hour, operates at a belt speed of 28 ft. per min., and is built of wood. The principal dimensions are as follows: Length over-all, 19 ft. 10 in.; width, 6 ft. 6 in.; height, 6 ft. 9 in.; triangular tank, 12 ft. long by 6 ft. wide by 3 ft. deep, with a bottom 23 in. wide and flaring sides. Head pulley is 20x21 in., tail pulley 48x22 in.; rubber belt, 20 in. wide, 6 ply; the flights are angle-shaped, 4x4x20 in. long, made of 3/16-in. steel plate bent to shape and bolted to the belt. The drag is driven by two sets of gears, belt, and pulleys from lineshaft, and the power required is about 5 hp.

Water consumption in the Hancock jigs is low, and a 10,000-gal. cypress tank is used for storage, the principal source of supply being the mine. We estimate the average water required for operating these four jigs at about 300 g.p.m.

Tonnage of ore handled per jig, when operating under our conditions, is about 9 tons of feed per hour (that is, where we have to skim a lead middling in addition to the hutch concentrate). When running on tailings the capacity per jig per hour was as much as 12 tons of feed per hour.

The following data include the average analyses of ore products handled in the rougher plant:

	CaF_2 %	SiO_2 %	$CaCO_3$ %
Crude ore.....	40.82	4.19	52.93
Rough concentrate..	63.86	2.78	33.68
Tailings.....	9.74	4.15	85.24

Labor required to operate this part of the plant is four men; a head jig man in general charge, a second jig man and two spigot men who attend to drawing off the jig hutches, cleaning up, and similar work.

The Cleaning Section

By the name "cleaning section" we now designate the original mill started up in 1922. This is a concrete and steel building 148 ft. long by 63 ft. wide in plan. It houses the crushing machinery, the screens, and six Harz-type plunger jigs, as well as necessary elevators and conveyors.

As a glance at the flowsheet will show, the work of the finishing section starts at the mill bin, in which is stored the crushed ore, either rough concentrate from the rougher jigs or crude ore rich enough to be finished direct on the finisher jigs. The general principles underlying the operation of this part of the milling operation are common to all the plants in the Kentucky-Illinois fluorspar district, with variations in detail and construction.

Close sizing is necessary for good jig work, and Leahy vibrating screens are used for this purpose. Woven-wire screens of the long-slot opening type are the most satisfactory sizing medium for this type of screen.

Lead concentrates are produced from Richards Pulsator jigs, which are arranged in series with the spar jigs, a dewatering box taking the tailing from the Richards jigs and, after diverting part of the water, passing the feed to the spar jig.

There are six spar jigs of various sizes, in general design following Missouri practice, the hutch boxes of the five larger ones being built of re-enforced concrete. The smallest jig is of wood construction. Although the concentration ratio is low (1½ to 1), the jigging operation is a little unusual in that a great deal more concentrates must be handled than tailings, and it is difficult, if not impossible, to make a low-grade tailing. This difficulty is solved, at this plant, by passing all the tailings from the cleaner jigs back to the roughers, so that runovers, spills, and other causes of high tailings are taken care of automatically.

All fine material in the jig feed passing through an 8-mesh screen having an 0.062 opening goes to the tables. This size of opening is practically the same as the 10-mesh on the Tyler Standard Screen Scale. In use in this mill now are four Deister Plat-O tables equipped with zig-zag riffling, one of our developments, which tables produce five products; namely, lead concentrate, lead middlings, spar concentrates, spar middlings, and tailing. No attempt is made to classify the feed to the tables, as better work is done on unclassified feed and the tables themselves make good classifiers, the spar middling really being a classified product which is treated on a sand jig with good results.

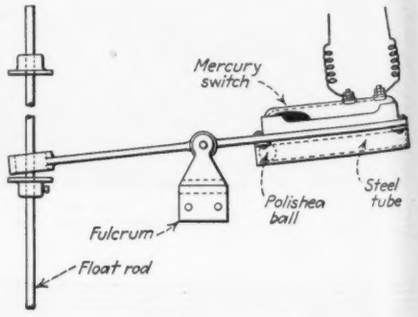
The nominal capacity of the finishing jigs and accessories is 6.5 to 8 tons of finished product per hour.

The average analysis of the finished gravel spar as shipped to various users is as follows: CaF_2, 85.82 per cent; SiO_2 2.31 per cent; and $CaCO_3$ 10.66 per cent.

A laboratory and chemist are provided. Chemical control is a very necessary step in the process of concentrating fluorspar.

Improved Mercury Switch

MERCURY SWITCHES employed for starting and stopping water-supply pumps automatically are usually actuated by a float arrangement installed in the pump sump. Under normal conditions, if the pump sump is in a sheltered position, no difficulties will be experienced in the operation of the switch. Should the water level be disturbed by an abnormal inflow of water or by wind, however, the vibrating rod attached to the float may fail to open or close the switch rapidly, and the conditions created may cause arcking. L. E. Davis, chief electrician of the Santa Cruz Portland Cement Company, Davenport, Calif., avoided the development of such difficulties by equipping the mercury switch with a movable counterweight. As indicated in the accompanying sketch, a small ball in the tube secured to the base of the switch rolls to the opposite end of the tube the moment the float rod touches the switch lever, causing the other end of the switch lever to dip suddenly and thus close the circuit.



Bag-House Failures Detected by Photo-electric Tube

Device Gives Instant Warning, Preventing Loss

J. S. Bowman

Westinghouse Electric & Manufacturing Company, Denver, Colo.

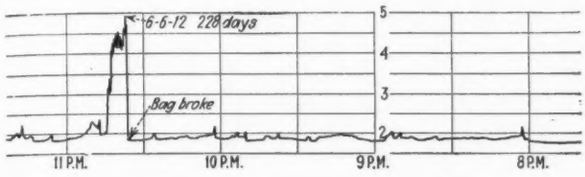


Chart showing an instance of bag failure

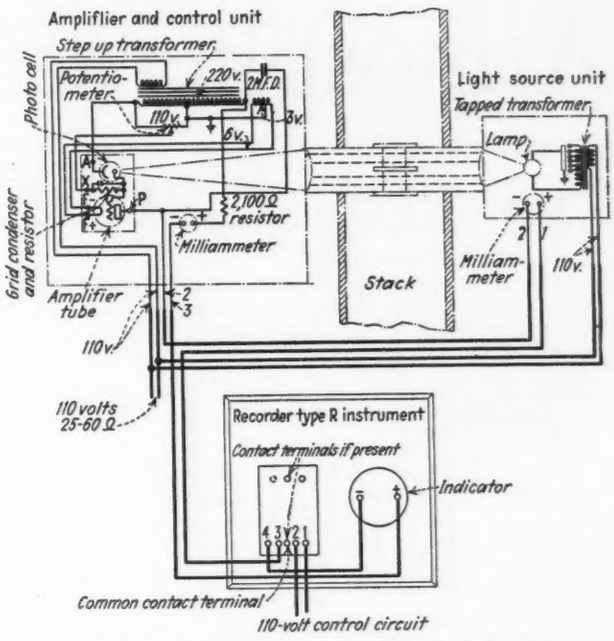


Diagram of connections for bag-house indicator

A PHOTO-ELECTRIC TUBE is employed at a zinc smelter in Mexico to record and notify operators when a bag in the bag house bursts, with the consequent loss of valuable metal particles up the flue. Inasmuch as the phototube gives instant warning of such failure the apparatus has more than paid for itself.

The bag house is built in sections each containing approximately 72 bags. The sections are independent except that they receive the gases from the roasters through a common header, and after passing through the bags the gases are discharged into a common stack. Each section has a large air-operated, manually-controlled mushroom valve near the bottom of one side for shutting off the gas when the section is taken out of service.

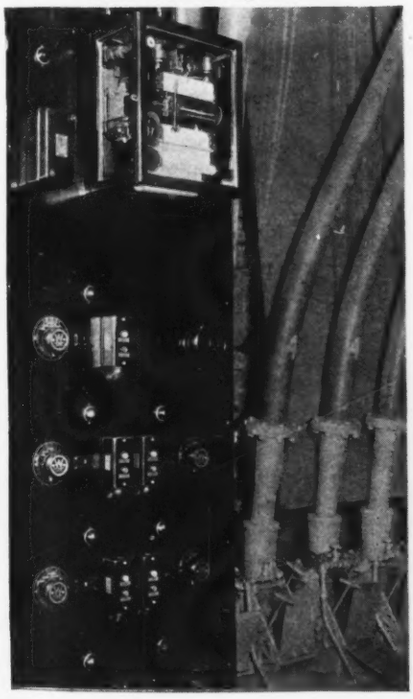
Fundamentally, the protective device depends on a ray of light which is passed through the flue gases. The opacity of the latter is measured by the amount of this light received by the phototube on the far side of the stack. The current delivered by the phototube operates a recording meter in the office. When a bag tears, the resulting dust reduces the light intensity so that the meter reads approximately half scale. Preadjusted contacts cause a Klaxon horn alarm to sound.

The photo-electric installation consists of two main parts: first, the light-source unit and the photo-electric amplifier and control unit, mounted on opposite sides of the stack; second, the recording instrument and alarm located in the operating room. The beam of light varies in intensity with the gas density. Variations in the light striking the cell cause like variations in the current flowing through the cell. This current when amplified is measured by a recording instrument.

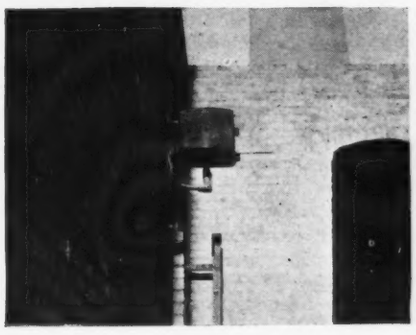
The light-source unit consists essentially of a low-wattage incandescent lamp, a lens for collecting the light rays into a parallel beam, and adjustments for proper focusing. The amplifier and control unit contains the photo-electric cell on which the beam of light is focused. It also contains a necessary transformer and control to adjust and operate the amplifier properly. Fogging of the lenses is prevented by a small hole in the mounting pipe which allows fresh air to be drawn into the stack ahead of them. The unit operates only from alternating-current at 110 volts, 25 to 60 cycles, no other source of electric energy being required.

The circuit is designed so that when both the light-source unit and amplifier unit are connected to the same source of supply the apparatus compensates automatically for effect of changes in line voltage up to plus or minus 5 per cent. The only maintenance expense is the replacement of the three tubes every six months.

This recording meter sounds an alarm when a bag breaks

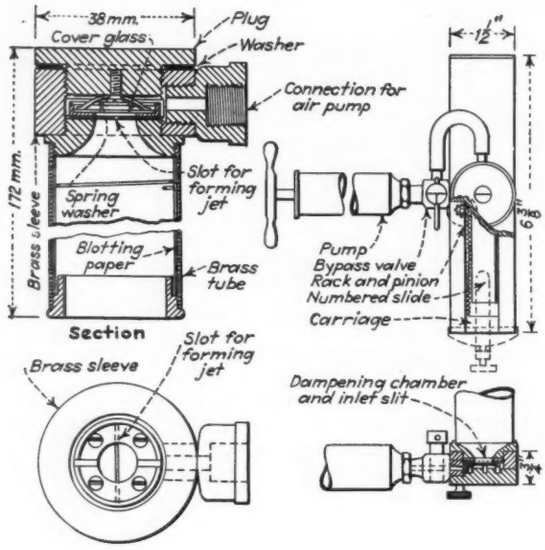


Light source in weatherproof housing on side of stack



Housed phototube on opposite side of stack

Atmospheric Dust As the Cause of Silicosis



Left — Owens' jet dust counter, discussed in text (Proceedings of the Royal Society, Vol. 101). Right —Modified multi-sampling Owens' dust counter (Theodore Hatch and E. Ward Thompson, Journal of Industrial Hygiene, March, 1934).

Its Sampling and Classification a Logical Approach to the Study of the Problem

Apparatus and Procedure Employed Have Been Steadily Improved

B. F. Tillson

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SPECIFIC ATTENTION has been called in an earlier article[1] to the danger of presuming that the cause of silicosis was definitely determinable by an examination and analysis of the dust particles detectible in the lung tissue upon post-mortem investigations. The production of toxic effects requires the solution of the mineral particles to permit chemical reactions. Possibly other pathological effects may be produced by the surface adsorption or catalytic influence of such particles, and the ingestion, transportation, and local aggregation of such particles as inert extraneous masses in the phagocyte (scavenging) cells may so impair the normal activity and duties of the latter as to produce a functional disorder or assist the development of diseased conditions; or these dust particles may prove mechanical irritants.

The author wishes to make general acknowledgment to such sources of information as the publications of the U. S. Bureau of Mines, U. S. Public Health Service, Associated Industries of New York State, Harvard Engineering School, the Chemical, Metallurgical & Mining Society of South Africa, and such text books as Burn's "Biophysics" and Cunningham's "Anatomy."

[1] "Silicosis — Its Causation: Mechanical and Physiological Aspects, *E.&M.J.*, March, 1934.

The pathology of silicosis is strongly indicated as toxic in its origin and a solution of silica or silicate particles is consequently necessary. Therefore the presence of dangerous mineral particles in post-mortem lung tissue is not to be expected where the victim had been free from dust exposure for a long period of time. But the solution of silica or silicate particles is probably slow and the ratio of volume to surface of spheres is proportionate to their diameters. The smaller particles are therefore more quickly dissolved and the larger particles of a given mineral will be found in the lung tissue in a higher percentage, either by count or mass, than they occurred in the inhaled air. Dusts, moreover, often have a mixed mineral composition, and difference in the solubilities of minerals will further lessen the value of determinations of the mineral content of lungs. The normal presence of mineral salts in the body tissues and fluids and the variation of their content with different individuals is an obstacle to the formulation of sound conclusions from chemical analyses of lung substance. The non-destructive separation of all mineral particles from lung tissue has not been satisfactorily devised and therefore microscopic and petrographic determinations of dust recovered from lungs cannot be relied upon for a final answer as to the cause of silicosis.

What then is the best way to approach this problem? Probably the most reasonable and productive method of attack is carefully to sample and classify the number, weight, size, form, mineralogical properties, and chemical compositions and reactions of the dust particles in a standard volume of the air breathed by those who become afflicted by this disease. Then the component mineral particles of the dust found should be separated in accordance with these classifications and should be tested in living subjects, such as animals, for the biological reactions and the resulting pathology. In such a manner a strong indication can be developed of the relative importance of these factors in causation. That greater progress has not been achieved from the investigations of the past thirty years is probably largely due to the tendency to concentrate attention upon the analyses of post-mortem lungs and unscientifically to assume that free silica (quartz) is alone responsible. Such an assumption was based largely upon the observation of quartz particles in the residue and ashes of lungs and also upon the large quartz content of the rocks in mining districts (especially in the Transvaal) where silicosis appeared. More recent medical experiments showed that fibrotic growths in the lung tissue (so characteristic of silicosis) could be produced in animals by the inspiration or injection of quartz dust in them. So the presence of other minerals in the dust has been ignored as a causative agent until recently, when Dr. W. R. Jones, a British geologist, presented a strong case for the con-

sideration of a silicate mineral, sericite, as another causative. His work emphasizes the great importance of an analytical engineering approach to this problem.

We are thus led to the importance of the engineering problem of making correct determinations of the dust content of air to determine:

1. The nature of the dust responsible for silicosis;

2. The concentration of, duration, and amount of exposure to harmful dust particles which exceeds the protective, eliminative, and tolerative capacity of the human body (with consideration given to the variation that occurs in individual susceptibility and infections);

3. The need for precautionary (dust elimination) measures in any vocational operation, process, or department;

4. The extent to which such measures should be applied to provide a safe breathing atmosphere;

5. Effectiveness of methods used for dust elimination or for prevention of harmful dust inhalation; and

6. Whether a silicotic could have contracted that disease in a certain vocation in a prescribed plant.

The accuracy of the dust determinations depends upon the apparatus, the technique, the aptitude of the technician, and the conditions associated with the observations.

Sampling Apparatus

Obviously, the first step is to procure a known quantity of dust-laden air; the second is to remove the dust from it. The first step has been achieved in many ways:

a. By displacing water from a closed vessel and thereby sucking air into that known capacity of vessel;

b. By displacing the piston in a suction pump, similar in appearance to a hand-operated tire pump;

c. By pumping water from one closed vessel to another alternately, thereby sucking the air into the space previously occupied by the water;

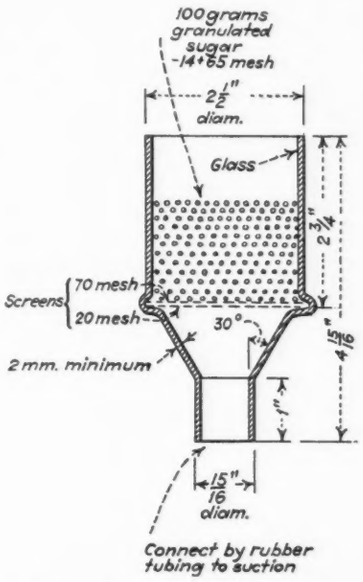
d. By use of a blower or other rotary displacement or fan type of suction pump to suck in a volume of air which is measured by devices such as displacement, pitot tube, or orifice meters;

e. By a fluid jet aspiration of air in accordance with the ejector principle, and with various methods for metering its rate of flow;

f. By bellows of known displacement.

All of these methods are suction methods and the maximum pressure differential to produce flow would therefore be the atmospheric pressure of about 14.7 lb. per square inch. The sum of all of the frictional and dynamic pressure head losses of the sampling and collecting system cannot exceed such a gross value. For good reason, the standard practice has been to place the dust-collecting system on the suction side of the air suction and displacement machine.

Perhaps the earliest dust-collecting device for sampling air was that of Franklin in 1886 to determine the bacteria content of air. In Vol. 178 of *Philosophical Transactions* of the Royal Society, England, he described a tube of $\frac{1}{4}$ in. internal diameter containing granulated sugar as a filtering medium through which a known volume of air was aspirated. G. A. Soper used a similar method in 1905 to 1907 to investigate the dust content of the air in



Sugar-tube dust sampler, Type B, U. S. Bureau of Mines

the New York City subways and was probably the first to use industrially a sugar filter for determining dust in the air. In 1911 the Consolidated Gold Fields group, in the Transvaal, using a water displacement aspirator, began regular determinations of dust in the mine air by the sugar-tube method, and in 1913-14, when a dust survey was made of all the mines, A. M. Johnston used with it an improved type of double-acting, bicycle-type, hand suction pump displacing about 3 liters per double stroke.

In the United States Dr. A. J. Lanza and Edwin Higgins used the sugar-tube method of dust sampling in their Joplin, Mo., silicosis studies in 1914 and 1915, the American Public Health Association having adopted it as the standard in 1912. In this country the sugar-tube sampler has also been used for dust counts and chemical or mineralogical determinations; in the Transvaal it has been used almost exclusively for determining the weight of dust. The low rate of sampling (5 cu.ft. in 18 minutes) standard in the United States was considered undesirable and so other samplers were tried, among them the Palmer water spray apparatus, the Whatman filter paper thimble, and the Anderson and Armspach dust determinator.

As a result of joint studies started in 1922 by the U. S. Bureau of Mines and U. S. Public Health Service with the above dust samplers and the Kotze konimeter, in general use in the Transvaal, a new dust sampler—the Greenburg and Smith Impinger—was invented. It is described in Public Health Bulletin No. 144 of 1925 and Public Health Service Reprint No. 1528 of 1932. More will be said about this device later.

The following objections may be raised to the sugar-tube method of sampling dust. The solubility of fine particles of silica or other minerals in water introduces an error; the human equation in air pumping introduces an unknown variable; the ignition of the filter paper and residue may alter the composition, size, and mass of the dust particles; the direction and velocity of influx of air and dust in the sample tube does not simulate man's breathing conditions; the method is practical only for gravimetric sampling, for although the residue be suspended in a fluid, an aliquot part taken, and dust counts made, the process is tedious and errors are magnified.

An Unknown Error

Another objection is that the particulate count of the dust from filter paper ash and that which is always contained in the sugar is an entirely unknown error. If a dust-free crystalline medium soluble in a liquid which does not dissolve the mineral dust particles were available at a modest cost, or if it and the solvent could be cheaply recovered by evaporative processes, great improvement could be made upon this general method. It should be possible to utilize low temperature vacuum evaporation to supplant filtration and subsequent ignition of the filtering medium if a fortunate selection was made of the dust-collecting chemical and its solvent.

Dr. J. Moir, of South Africa, published in 1915 a method for separating the large and small particles by levigation. To determine the settling rate of quartz particles suspended in water, where V equals the velocity of falling in centimeters per second, and D equals the diameter of a particle in microns, he used the following formula,

$$V = \frac{7D^2}{100{,}000}$$

In practice, where particles above 12 microns in size were to be settled out, the time in minutes was calculated as four times the number of centimeters height of the column of the liquid. The supernatent liquid which contained the finer particles was siphoned off; then

the residual liquid was diluted to its original bulk and allowed to settle for one-half the former time and siphoned off. The two liquids siphoned off were added together, filtered, and the dust was estimated as has already been described in the preceding.

In his 1904 Report on the Health of Cornish Miners, Dr. J. S. Haldane blames the great increase of Cornish miners' phthisis upon the increased dustiness of rock drilling and especially blamed service in the Transvaal. He claimed that 4.7 years' average service in the Transvaal applied to affected men who had worked only there. The following figures of dust content in milligrams per cubic meter of air appear in the 1902/3 first Report of the Miners' Phthisis Commission, Transvaal—

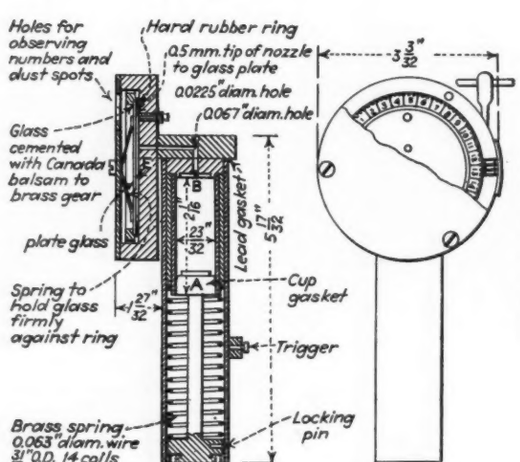
As early as 1878 Aiken devised a dust counter by drawing a sample of moist, dust-laden air into a cell, then lowering its pressure and temperature below the dew-point by means of a suction pump, so that the moisture condensed on the dust particles caused them to settle upon an observing plate, where they were counted. The method was found to be inaccurate because there was no assurance of the settling of all the dust particles upon the observing plate.

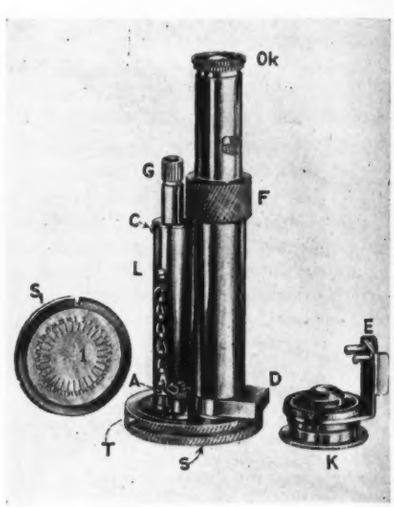
However, Dr. J. S. Owens, of England, announced in the 1922 Proceedings of the Royal Society, Series A, Vol. 101, pp. 18 to 22, a new type of dust counter which combined Aiken's principle of moisture condensation with the principle of particle impingement

perature of the glass the moisture evaporates and leaves a fine band of dust adhering to the disk-shaped cover glass. About six strokes of the pump are made at the place of sampling before insertion of the cover glass. This is done to insure that the proper humidification of the air takes place in the humidifying cylinder.

Where the mine atmosphere is approximately saturated, the use of the humidifying cylinder is unnecessary and no preliminary strokes of the piston are required. The number of cubic centimeters of air sampled depends upon its dust content. Usually 150 c.c. (or the equivalent of three pump strokes) on a single cover glass is found to be satisfactory.

In New South Wales, the Owens'


Holes for observing numbers and dust spots
Hard rubber ring
0.5 mm. tip of nozzle to glass plate
0.0225" diam. hole
0.067" diam. hole
Glass cemented with Canada balsam to brass gear
plate glass
Spring to hold glass firmly against ring
Lead gasket
Cup gasket
Trigger
Locking pin
Brass spring 0.063" diam. wire 31/32" O.D. 14 coils
diam.



Left, Circular konimeter developed by James Boyd, Transvaal, South Africa. Right, Zeiss konimeter, with condenser removed and a spare disk S_1. Ok, the eyepiece; F, fine focusing adjustment for objective; G, handle of air pump; A, mount for the jet through which air sample enters.

face of a drive, 424; face of another drive, 192; where a spray of water is directed toward face of a drive and sample taken behind spray, 42; one hundred feet from a face, after a blast, 83; end of drive 5½ hours after blasting, 43; one stope, 14; another stope, 32; a raise, 164.

Dr. Haldane, in his two books "Investigation of Mine Air," 1908, and "Methods of Air Analysis," 1912, describes the use of a pad of cotton wool as the filtering medium which is finally ignited so that the residue of dust may be weighed.

One of the earliest methods of dust sampling in the Transvaal is that reported by C. Toombs as the aspirating of a known volume of air through water in a wash bottle, with subsequent evaporation of the water and weighing of the residue. The use of the sugar tube was first suggested in the Transvaal, South Africa, by W. H. Jollyman as far back as 1907.

against a collecting surface, as was devised by Sir Robert Kotze, of the Transvaal, in the invention of his konimeter in 1916.

The Owens' dust counter is a small single-stroke hand pump (or syringe) which sucks in 50 c.c. of dust-laden air at a high velocity through a fine slit 10 mm. long by 0.2 mm. wide and produces a jet which impinges against a cover glass 1 mm. away from the slit. If the 50 c.c. displacement of the piston is made during a time interval of one second the jet velocity is 4,921 ft. per minute. The adiabatic expansion of the jet lowers its temperature and condenses on the dust particles the moisture which the dust-laden air has absorbed from the damp blotting paper which lines the wall of the humidifying cylinder into which the air to be tested is first drawn. The moisture-coated dust particles are thus shot against the cover glass and adhere to the same, but due to the impact and the higher tem-

dust counter is much used as a sampler. For counting, a 1/12-in. oil immersion objective lens is employed on the microscope, with daylight illumination, and a magnification of 790 diameters. Particles as small as ½ micron are clearly defined. The ocular of the microscope is equipped with a square-ruled micrometer and also carries a photographic charting of ten black disks of diameters equivalent to 1, 2, 3, etc., up to 10 microns for comparison in judging particle sizes. The length of the dust streak on the cover slip is 10 mm. (that is 10,000 microns).

To determine averages for a period as long as one-half hour a procedure was worked out for taking samples at the rate of four samples during each five minutes. Different observers with different Owens' instruments are reported by Dr. Badham to check each other well when sampling the same air. P. S. Hay, of England, states that the ap-

paratus has been found too delicate and complicated for routine tests underground, for which purpose he evidently favors the konimeter. He considers the Owens' better adapted for laboratory use or for determining general atmospheric pollution. Dr. Badham, of New South Wales, states that the instrument does not give as large a count as the Impinger when sampling very dusty air, because of the clumping and masking of particles when counting; but in well ventilated workings where the dust count is less than 200 particles per cubic centimeter he considers the Owens' superior to any gravimetric instrument like the Impinger because the latter must be kept running for many hours to collect sufficient dust for accurate weighing. A further objection raised against the Owens' device by devotees of the Impinger is that the former takes only a grab sample, and so does not give an average value. The same claim could be made against any discontinuous sampler like the konimeter. But Dr. Badham claims that the Owens' counter gives an accurate indication of the amount of dust in the air when the sample is taken; and I propose that maximum conditions of dustiness during a cycle of operations are far more important than the average values over a number of operating cycles as must result from the long time sampling by an Impinger, for the damage is done to the worker when the protective and eliminative capacities of his body are exceeded. The grab sample objection therefore seems to have no merit.

Owens' Counter Selective

Dr. J. W. Fehnel, in making certain additional objections to the Owens' dust counter, states that Theodore Hatch, of Harvard, has demonstrated that the Owens' counter is selective, and samples only dust particles smaller than about 6 microns.

In an excellent address before the American Institute of Mining and Metallurgical Engineers, Dr. Greenburg, one of the developers of the Impinger, stated that the Owens' sampler was the most efficient instrument that he knew of for sampling directly air for particle size determinations. He considered it necessary to deposit the dust directly from the air upon the microscope slide to obtain as representative a sample as possible of the dust as it exists in the atmosphere. He also emphasized the importance of the small size of the dust particles in regard to their dangerous effect upon the respiratory tract. However, he has found difficulty in the photographic investigation of Owens' dust slides because the particles do not lie in one focal plane, or at any rate the larger particles do not focus sharply with the microscope setting proper for the smaller particles. The blurred outline of a particle makes it seem larger than it is.

Convenience in manipulation and saving in time in both sampling and making the microscopic dust counts have brought about the design of dust samplers which collect a number of dust spots upon one slide. The Circular konimeter was the first of these. Next came the Zeiss konimeter, and now we have the multi-sampling Owens' dust counter which is described by Hatch & Thompson in the March, 1934, issue of *The Journal of Industrial Hygiene*. The newer Owens' dust counter makes it possible to obtain results that are approximations and will serve for guidance in plant control.

The Konimeter

Reference has already been made to the Kotze konimeter (see illustrations on p. 219 of May issue of *E. & M. J.*), which was the first device to impinge the dust sample against a surface. Sir Robert Kotze displaced a small volume of air (5 or 10 c.c.) by a spring-actuated piston which completed a stroke in one-third of a second and sucked the dust-laden air through an orifice 0.6 mm. in diameter to produce a jet which struck a glass slide 0.5 mm. away. He used a standard English microscope slide cut in half lengthwise and sealed it by a rubber gasket against the jet chamber. A lateral shifting of this slide permitted a number of dust samples to be taken on one slide. The velocity of the air at the impinging nozzle was between 30 and 80 meters per second (5,906 to 15,748 ft. per minute). To count the dust particles the comparatively low magnification of 120 to 180 diameters was used in a microscope having a 16-mm. objective lens and a high-power eyepiece with a micrometer ruled either in squares or preferably a sector ruling with two lines at 18 deg. to each other and cross lines to facilitate counting. Two additional lines are ruled outside the sectors so as to appear 5 microns apart, and act as a guide in estimating particle sizes.

From his design various improved types of konimeters have been developed by others. The Circular konimeter uses a large glass disk graduated in sectors to receive 60 sample spots and with a micrometer rotating mechanism for placing any certain sector in front of the jet; and the piston-actuating spring is enclosed in a brass tube for protection against damage. The Zeiss konimeter is said by P. S. Hay, of England, to be 50 per cent more efficient in dust catching than the Kotze konimeter. It uses a glass disk graduated into 30 sectors for the same number of dust-sampling fields. A stop is provided on the spring-actuated piston so that either a 5 c.c. or a 2½ c.c. sample of air may be drawn in. It comes in two models: one of the sampler alone, from which the disk is removed for inspection on the stage of a separate microscope; and the other model with a microscope of 200 diameters magnification and a dark ground condenser mounted as a unit with a jet sampler. The eyepieces of both microscopes are provided with micrometers ruled in squares whose sides appear 0.1 mm. long but on a special order a finer ruling as small as 0.01 mm. may be obtained.

Originally an ordinary light ground illumination was used to view konimeter slides. Very fine particles were found not to be observed, however, so a modification of dark ground or oblique illumination is now used with a stop of about 10 mm. diameter placed immediately below the condenser to cut out the central portion of the light pencil which illuminates the particles. A 100-c.p., ½-watt ground glass electric light is placed 9 to 12 in. from the mirror. The slides are coated with an adhesive to catch the dust particles; and the original vaseline coating has now been supplanted by a very thin coating of glycerine jelly, but where the sampled air is moist no adhesive is necessary because of the moisture condensing on the particles from the expansion of the jet and its consequent chilling. The presence of mineral salts in the moisture of the Transvaal mines caused vitiation of the konimeter dust spot samples by the crystallization of the salts on the slide when the moisture evaporated. However, treatment of the slide by hydrochloric acid fumes dissolved these extraneous crystals without dissolving the particles of silica. But fine carbon, oil, and tar particles from acetylene lamps and the lubrication of the rock drills also contaminated the samples. With dark ground illumination one could not determine a carbon particle from one of silica, but with light ground illumination it was sometimes possible to differentiate them. With the standardization on dark ground counting, it became necessary to eliminate the carbon spots. An attempt was made to burn them off from pure silica slides which replaced the glass slides, but the silica slides were not transparent enough, so the method finally evolved was to wash the whole slide in dilute hydrochloric acid, rinse thoroughly in distilled water, and dry it. The mineral salts dissolved and the carbon disappeared, or floated off.

The Personal Factor

The personal factor enters largely into konimeter dust counting, for which the same microscope, magnification, and illumination, experienced observers have differed as much as 40 per cent in their counts. Also, since the particles are so minute it is impossible to differentiate between silica and non-silica dust, or even between silica and such other dusts as lime, flour, sugar and carpet dusts. However, the konimeter has been generally used in the Transvaal mines, for it offers extreme portability and rapidity of making comparative determinations.

(To be continued)

A Hand-Drilling Job In the San Juan

Cost of Reviving the Lizard Head Prospect

Robert B. Dickson

Mining Engineer,
New York

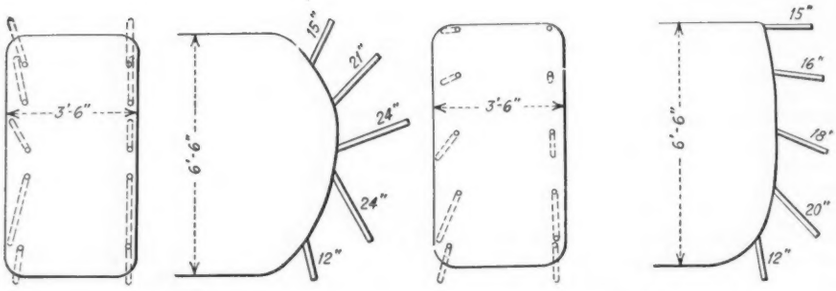


Fig. 1 Fig. 2

Hand-drilling rounds used in Lizard Head drifts

THE FOLLOWING ACCOUNT of development at the Lizard Head mine in 1933 indicates the cost of resuming work at one of the numerous prospects in the West. Probably the costs are not the lowest that could be attained, but they may serve as a basis for comparison with other similar two-man operations. The mine is at an elevation of 12,250 ft. on the southeast slope of Wilson Peak, in the Mount Wilson Mining District, 9 miles west of Ophir, Colo. It is reached by a 6-mile trail, climbing 2,250 ft. from the Montrose-Rico-Dolores highway near Lizard Head Pass. The ore consists of gold- and silver-bearing galena and sphalerite in a gangue of calcite, sericite, siderite, pyrite, chlorite, and quartz. The ground is fairly soft, and drilling is done by hand.

Because of the difficulty of moving supplies over the trail in winter, all of the winter's requirements had to be packed up in advance. Except for fresh meat, eggs, and similar perishables, enough supplies were taken up in October to last a year. Their high cost and the difficulty of getting immediate delivery on even such items as dynamite made it desirable to outfit in Denver. A 1926 model ¾-ton Reo truck was bought for $110. It paid for itself within two weeks. A load consisting of 1 ton of dynamite, 9,000 ft. of fuse, and half a ton of staple groceries and tools was taken to the foot of the trail, over four mountain passes in four days, a distance of 400 miles. Although pack animals are scarce in the San Juan, in contrast to their great numbers when mining was active, an experienced man with four mules was found. Seventy-eight mule loads were taken up in sixteen days from Oct. 6 to 21 for $100. On Nov. 15, a supplementary trip with fresh beef was made.

The prospect had been idle since 1926. Considerable repairs to the cabin were necessary, as well as 25 ft. of new snowshed. Scrap lumber was used for the outside of the shed, but the frame was built of freshly cut spruce, the only new timber used in the mine. The mine car, several steel rails, the drill steel, several hammers, and a few miscellaneous tools of small value were all that had escaped the marauders in the years the prospect had been idle.

Development work consisted of two 3½x6½-ft. drifts on the vein from a 90-ft. crosscut driven years ago. The work proceeded steadily, and although 8 ft. of snow fell before Jan. 1, it caused little trouble. The trail was open to horses until Nov. 29. After Nov. 1 about 10 per cent of the time on shift was spent picking ice in the snowshed and the outer portion of the tunnel. After Dec. 1, an additional 10 per cent was spent sorting high-grade. Consequently, the steadily improving performance does not show in the footage. Sixty feet of drift was completed in 1933 at a cost of $10.78 per foot. This was necessarily high because of the expense of reopening the prospect. All tools and improvements were charged to the work at a rate that would write them off in twelve months. Table I shows the expenditures and the itemized cost per foot. Table II shows how the time was devoted to various classes of work. Table III shows the mining and powder statistics.

Both of the drift rounds shown in Figs. 1 and 2 are used. A complete

Table I—Expenditures During 1933

	Total Cost	Charged to 1933	Cost per Foot
Truck, original cost	$110.00	$12.25	$0.204
Gasoline, oil, and grease for truck	30.34	7.58	0.126
Passenger automobile expenses	26.49	13.25	0.221
Hotel and meals	32.25	16.12	0.269
Packing, 81 mule loads	110.00	33.00	0.550
Groceries	312.66	93.80	1.563
2,000 lb. 40% special gelatin	280.00	35.35	0.589
3,000 No. 6 blasting caps	45.28	7.00	0.117
9,000 ft. Black Monarch fuse	57.60	5.68	0.095
6,000 lb. coal in sacks	20.10	6.70	0.112
420 ft. 1x12-in. yellow-pine planks	10.50	2.63	0.044
40 ft. corrugated sheet iron	5.60	1.40	0.023
578 ft. 8-lb. mine rail, second hand	31.00	6.20	0.103
200 lb. calcium carbide	17.75	4.43	0.074
Stove with water back	30.90	7.73	0.129
Forge blower, second hand	12.50	3.12	0.052
Tools and utensils	71.44	17.86	0.298
Miscellaneous, including radio	48.87	24.43	0.407
Assaying	13.19	13.19	0.220
Labor, 44 shifts at $2.50	110.00	110.00	1.833
Salary, three months at $100	300.00	225.00	3.750
Totals	$1,676.47	$646.72	$10.779

Table II—Distribution of Time

	Number of Shifts			
	Oct.	Nov.	Dec.	Totals
Purchase and haulage	14	4½	3	21½
Repairs to cabin	6	1½	1	8½
Rebuilding snowshed	5½	½	..	6
Surveying	½	¼	..	¾
Drilling and mucking	10	32	46	88
Track work	3	1½	1½	5½
Tool sharpening	½	1	½	2
Totals	39½	41	52	132½

Table III—Mining and Powder Statistics

	Oct.	Nov.	Dec.	Totals
Mining shifts	10	32	46	88
Feet advance	8	22	30	60
Feet advance per shift	0.800	0.688	0.652	0.682
Inches of hole drilled	878	2,698	3,769	7,345
Inches per foot advance	110	123	126	122
Inches per shift	88	84	82	83
Holes blasted	48	174	241	463
Inches per hole	18.3	15.5	15.6	15.8
Lb. of dynamite used (1¼x8 in.)	34.0	91.9	126.8	252.7
Sticks of dynamite (172 per box)	117	316	436	869
Lb. dynamite per foot advance	4.25	4.17	4.22	4.21
Sticks dynamite per foot advance	14.6	14.4	14.5	14.5
Feet advance per box dynamite	11.76	11.97	11.83	11.89
Feet of fuse used	97	310	463	870
Feet of fuse per foot advance	12.1	14.1	15.4	14.5

round is seldom drilled. The miner merely blasts what he has ready at the end of the shift and goes on with the round the next day, the number of holes varying from five to seven. Short holes, averaging less than 18 in. deep, are used because of vuggy, fitchering ground, and because longer holes break poorly. A slightly convex chisel bit is used. The drill steel is $\frac{7}{8}$-in. octagon carbon steel. Bit gage varies from $1\frac{7}{16}$ to 1 in. In contrast to the usual machine round, where except for the cuts the block of ground on each hole is long and thin parallel to the hole, in hand mining the block is short and thick. The break usually is to a point in the hole just below the center of the explosive charge, and a 3- or 4-in. hole is left over. More than half of these are reused in the first type of round, but only that left by the 24-in. upper in the second type. The latter requires more powder and calls for more inches of hole per foot of advance; but it is easier to drill than the first type, in which the top holes are slow and tiresome. Hand miners usually prefer the second type for the latter reason. One tends to drive the drift to a point with the second type of round, and with each succeeding lowering of the back it becomes more difficult to keep the roof at the proper height, thus necessitating extra holes. An important advantage of the first round is that in slabby ground the back is left even and in good condition, whereas the reverse is true of the second type. Apparently, the relative rates of advance show no difference.

Experiments in Zinc Metallurgy in Japan

Roasting of zinc-sulphide flotation concentrate especially by application of oxygen is the subject of a paper by T. Miyazaki and T. Oyama, published in the *Journal* of the Mining Institute of Japan (Vol. XLVI). As abstracted by the authors, laboratory tests of flash ore roasting and falling ore roasting in the oxygen atmosphere are described. The speed of oxidation of individual ore grains of various sizes in air and in oxygen at various temperature ranges from 700°C. to 900°C., and the modes of permeation of oxide into the heart of ore grain were measured by microscopic observation. Speed of desulphurization and rate of heat evolution of ore in air or in oxygen atmosphere in a specially made small laboratory furnace of cylindrical form are given. The authors emphasize that the complete agitation is the most important factor for fine-ore roasting, and the speed of roasting can be greatly increased by complete agitation in the air; nevertheless, the complete and quick elimination of the last few per cent of residual sulphur cannot be accomplished without the extraneous heating of the hot ore by the oxygen supply, especially toward the end.

Burning Lime With Producer Gas

An Economy for the Isolated Mine

Vincent Biava
Formerly Master Mechanic
South American Development Company,
Portovelo, Ecuador

APPLICATIONS of producer gas as a fuel for metallurgical and power purposes are as varied as familiar. A development of interest, especially to those in remote localities, is the use of producer gas for burning lime. The gas producer plant and lime burning kiln developed by the South American Development Company at Portovelo, Province of El Oro, Ecuador, is the result of considerable experimentation to perfect a method that would produce lime more economically—imported lime costing as much as $86 a ton.

Gas producers of the suction type, both up- and down-draft, were tried, and experiments were made to clean the gas, but the best results were obtained with the up-draft pressure producer here to be described. It was also found that the gas need not be cleaned prior to entering the four burners on the lime kiln. Dimensions of the gas producer and the lime kiln are shown in the accompanying drawings. Both were built at the company shops from scrap and salvaged material.

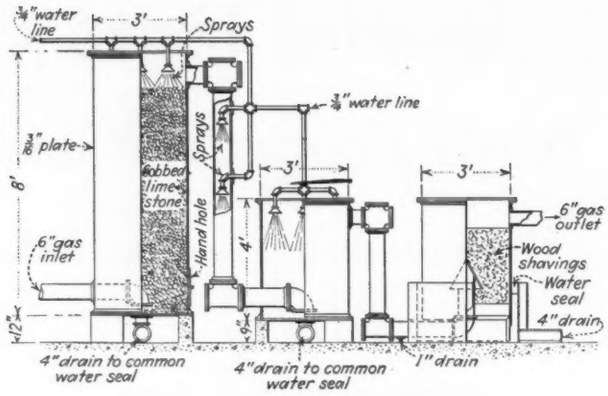
Fuel used in the producer consists of sawdust, sawmill waste such as slab and timber ends, and old mine timber. The size varies from sawdust, blown from the sawmill to the fuel bin by a blower conveyor system, to timber as large as 12x12x24-in., received over an aerial tramway. The limestone is derived from vein calcite, found in various parts of the mine. Some of it is obtained from ordinary operations, but the greater part is mined separately and cobbed to size underground.

Operation of the plant is simple, only one operator and one helper being required on each shift. Before starting the producer, its water-cooled head and the sump forming the water seal at the base are filled with water. A number of large pieces of wood are then dropped through the charge hopper to form a raft on the water inside the producer. Next, the blower is started and run at about half speed, after which a quantity of oily waste and wood is lighted and thrown upon the raft. This is followed by a charge of dry or easy-burning wood, which is allowed to burn down until the producer is half full of burning material. The producer is now filled with sawdust and waste wood and the speed of the blower increased to give a pressure of from 6 to 9 in., water gage. With the charge hopper cover clamped tight, gas is soon produced. A pilot valve is provided on the main gas line for testing the quality of the gas. The burners on the kiln are lighted as soon as the gas is sufficiently rich. An excessively hot charge hopper and poor gas indicate that more fuel is needed.

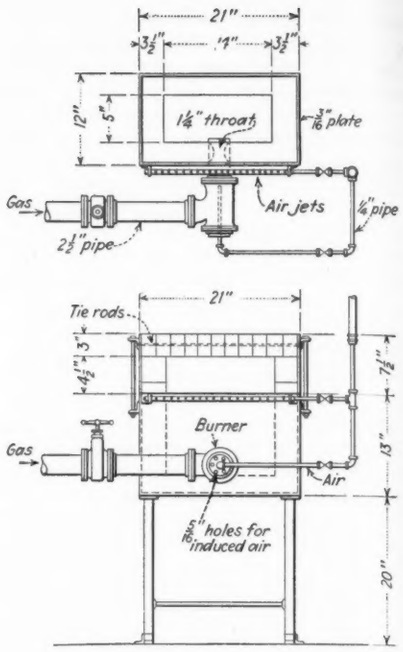
To charge the producer the blower is stopped and the compressed air to the burners is shut off. The clamps on the charge hopper are loosened and the cover is raised by a wire rope suspended from a sheave fastened to the roof of the building. On opening the cover, the gas remaining in the producer ignites with a slight explosion, so care must be taken not to stand near the charge hopper.

After the gas has burned off, the producer is charged with fuel, the hopper cover again clamped tight, and the blower started. After a few minutes the burners may be lighted and adjusted by regulating the compressed air at each burner. Once every 24 hr. ash is cleaned from the sump at the base of the producer. About six wheelbarrows of ash is removed daily. Ash also accumulates in the interior of the producer and must be removed periodically. When the kiln is being operated continuously, this is done once a month. To do it the fire is allowed to burn down, the hopper lid removed, and a stream of water played on the ash until it is cool. Next, the water is drained from the sump. An operator enters the producer and scrapes the ash from its sides into the empty sump, whence it is removed from the outside by rakes.

Tar and residue in transfer pipes and manifolds are removed once a week in the following manner: The blower is stopped and all covers are removed from the manifold. The blower is then restarted and run slowly to supply a little gas. A piece of lighted waste is placed in the manifold to ignite the gas therein, while compressed air is blown



Scrubbers at the producer-gas plant, South American Development Co.



Forge furnace, fired by producer gas, for heating drill steel

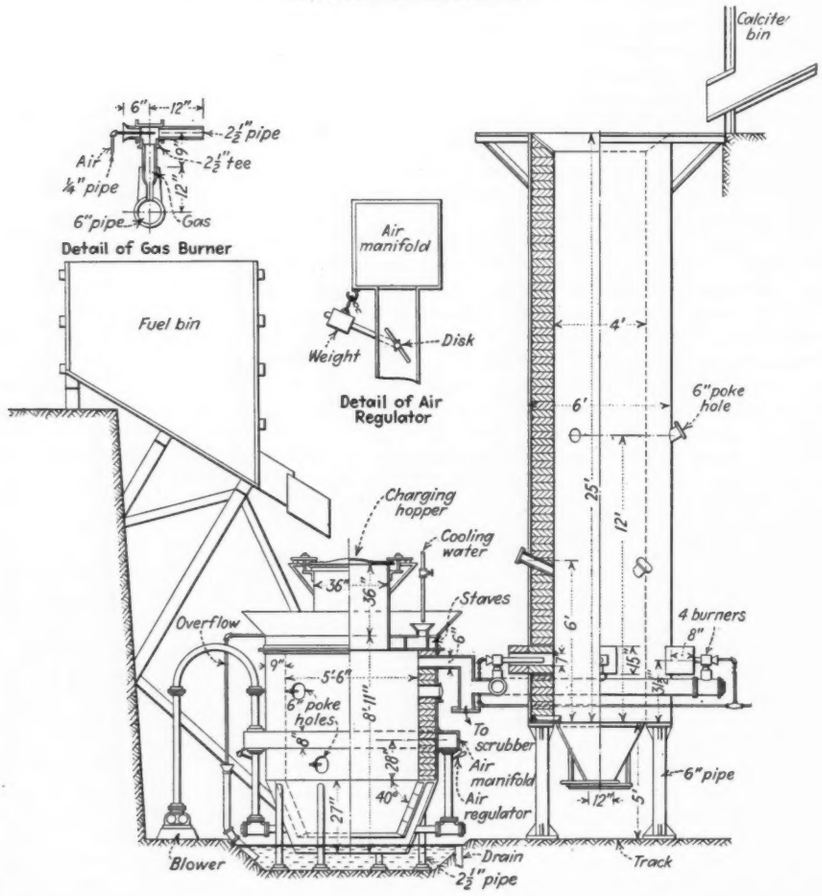
in by means of a length of ½-in. pipe connected to an air hose. The heat of the burning gas causes the residue to burn and the air jet is moved back and forth in the manifold until all the residue has been burned out. This operation is repeated at each opening. The burners on the kiln are cleaned once or twice a day by disconnecting the air pipe, lifting out the burner, and poking a rod through the hole to the manifold.

The lime kiln is charged at the top and the finished product is drawn at the bottom through a 12-in. gate. Calcite that will pass a 5-in. ring and remain on a 4-in. ring is the most suitable size for burning, but a mixture of calcite 5 to 2 in. in size is satisfactory. Small material tends to pack in the kiln, reducing its efficiency and obstructing the draft. Larger material requires more time in burning and creates the danger of slagging the kiln in the burning zone.

In charging for the first time care must be taken not to allow the calcite to pack too tightly, or it will not run. This can be avoided by lowering the material in a bucket until the kiln has been charged to a height of about 20 ft., instead of dumping it from the top of the kiln. After this the calcite may be dumped from the top until the kiln is fully charged.

After the burners have been lighted, 300 to 400 lb. of calcite is drawn off through the cooling cone every two hours to keep the charge loose and allow for expansion. Calcite not thoroughly burned is returned to the kiln for re-treatment. As soon as a well-burned product comes from the cooling cone, the kiln may be drawn continuously to the extent of 400 lb. of burned lime every two hours.

General assembly of gas-producer and lime-burning plant, Portovelo mines, Ecuador



A Cost Comparison

Costs are as follows: Local gas lime, 55.2 per cent CaO, costs $11.079 per ton. Imported lime, 82.8 per cent CaO, costs $86.80 per ton. Based on equal content of CaO, comparisons are as follows: Local gas lime costs $16.61 per ton; imported lime, $86.80, almost five times as much.

Gas from the producer has been scrubbed and used successfully for heating drill steel. The accompanying drawings show the scrubbers and the type of forge used. No gasometer is necessary in the lime-burning plant, as the time needed for charging the producer is short and the operator has complete control over the quantity of gas generated.

Sinking a Small Drop Shaft In a South African Brine Pan

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For the total depth of 100 ft. the cost was $83 per foot, including all equipment, purchased new and delivered. Only the author, who was in charge, and one workman, had had previous experience in mining

CHURN - DRILL HOLES put down on a South African brine pan, for the purpose of recovering the brine, showed the following structure: (1) 6 in. of loose surface sand; (2) 3 ft. of a mixture of stiff clay and sand; (3) 22 ft. of a mixture of clay and sand, bearing a weak brine containing about 48 grams of salts per liter; (4) 30 ft. of light impervious shale; and (5) 45 ft. of black permeable shale bearing a strong brine, carrying about 280 grams of salts per liter.

In sinking the holes, which were 6 in. in diameter, steel casing was used down to the impervious shale separating the two brine-bearing beds, and far enough into it to seal off the weak upper brine from coming into the hole to dilute the strong lower brine. The flow was sluggish, the strong brine not coming in fast enough to supply small deep-well pumps. Decision was made therefore to sink a small shaft in the "pan" to a depth of 100 ft. from the surface, and from the bottom of the shaft to drive radial collecting galleries or drifts until the brine inflow became greater than the pump capacity.

Although the bed of clay and sand carrying the upper brine looked as if it would allow only slow percolation, actually the brine seeped through it into any opening faster than the pumps could drain it. We therefore decided to sink a concrete cylindrical casing, of 6½-ft. inside and 8-ft. outside diameter, with 9-in. walls, down to the impervious shale, and to seal off the upper brine in the same way as was done with the steel casing in the drill holes; and, once the weak brine had been kept from coming in, to sink a shaft 4x4 ft. inside timbers, to the 100-ft. level.

This concrete tube was to be built up as a continuous cylinder on the surface, its bottom to be shod with a steel cutting shoe, the work to be done in such manner that, as each successive concrete ring became hard enough, the tube was to be let sink under its own weight until the top of the completed portion was flush with the ground, whereupon another ring would be poured and be allowed to sink when set, the material within the tube being excavated during the sinking.

To prepare the ground at the shaft site so as to reduce to a minimum the resistance to sinking, four 6-in. churn-drill holes were sunk on the corners of an 8-ft. square, with light galvanized iron "stovepipe" as casing, the holes reaching the top of the impervious shale. Into each, two 5-in. x 3-ft. cans of gelignite were lowered, one to the bottom and the other, hung by a wire, to a point 8 ft. above. These were of galvanized sheet iron, each with a bail and a cover pierced at the center by a 1-in. hole, into which was soldered a 1x1-in. tube having a perforated rubber stopper. Through the perforation was threaded a length of cordeau, bent into a loop at the end, the loop being placed in the can bottom. Each can was then filled with about 25 lb. of gelignite in sticks, and the covers were put on and the joints wrapped with insulating tape. The cordeau, which extended 20 ft. outside the can, was also wrapped with the tape because of its brittleness and the possibility of corrosion by the brine. The cordeau from the eight cans was spliced on the surface to a single short length to which was attached a single blasting cap and 6 ft. of fuse used to fire the charge. This would seem a heavy charge for the duty, but did not prove so when sinking the last few feet.

The initial blast. The drill rig on the left is 30 ft. high

After the blasting, the ground was leveled and two planks were laid in place with the cutting shoe upon them. This was of ¼-in. steel plate 18 in. wide and slightly over 25 ft. long, so that when rolled to a true circle, and after the two ends were electrically welded, the cylinder had an 8-ft. outside diameter. To its inside face and 3 in. above the bottom edge was welded an inner sheet of steel in the form of the peripheral surface of the frustrum of a cone and of such width as to bring the upper edge flush with the upper edge of the outer plate, with 9 in. between them.

Six 90-deg. steel lugs, each bored with a ¾-in. hole, were welded at equal intervals to the inner side of the outer plate. Into each hole was placed the end of a ⅝-in. 3-ft. iron rod, the upper end bent into a hook; the lower end, threaded for 3 in., carried two nuts, one below and the other above the lug, so that, when both were turned tight, the rod stood rigid and upright midway between the inner and outer plates of the shoe. Six additional ⅝-in. rods were similarly fastened to the inner plate, no lugs being used, and so spaced that each stood midway between the rods carried in the lugs. These were intended for re-enforcing the concrete and for suspending the shoe and the caisson to be built upon it from an overhead platform by means of other hooked rods hanging from eyebolts in the platform.

Two 150-ft. lengths of old 1-in. wire rope were now laid at right angles across the shoe, their centers being one above the other in the center of the circle. A bight of each was set in between the ⅝-in. rods and the shoe filled with a 2:3:5 mixture of concrete, selected to set quickly and to withstand the brine's corrosive action. A test had shown that an aggregate containing a smaller proportion of cement would crumble upon long immersion in the brine.

Forms used for casting the rings were 3 ft. deep and of ¼-in. steel plates and 3-in. angle irons joined by counter-

sunk rivets. The inner form had an outside diameter of 6½ ft., the angle irons being on the inside face. It was made in four segments bolted together, the bolts passing through angle irons, with a wooden filler strip 2 in. wide and sawed in two lengthwise diagonally so as to make a two-piece composite filler which served as complementary wedges, 3 ft. long with transverse bolt holes to match the bolt holes in the angle irons.

The outer form was of 8 ft. inside diameter and had the angle irons on the outer face. It was made in three segments, without fillers, the segments being bolted together, angle to angle. All three were marked at the factory so that the same ones could always be bolted together in the same sequence. When the outer and inner forms were set up, the latter inside the other, the space between was just 9 in., the intended thickness of the concrete of the tube or caisson.

After the concrete had been poured into the shoe, a set of two of the steel forms was placed over the shoe and carefully centered with 9-in. wood blocks so that the forms were exactly concentric with each other, and the four lengths of wire rope embedded in the concrete were drawn up through the space between the forms and held vertically in place. After this, concrete was poured until it came to the bottom of the hooked ends of the twelve ⅝-in. rods, a 25-ft. length of old wire rope being laid in and out alternately between the rods to afford horizontal re-enforcement.

A wooden platform was now erected over the work, supported by 8x8-in. posts 12 ft. high and carrying a floor of planks 4 in. thick. This had a 4x4-ft. opening to let the hoisting bucket pass. The post bottoms rested upon long and broad planks, these in turn resting upon other similar cross planks to distribute the weight that could come on the platform over a large bearing area of the recently blasted and consequently soft ground.

Around the opening in the floor was swept a circle on the planks with radius of 3 ft. 7½ in. At equal intervals on its circumference twelve ¾-in. holes were bored, each directly over and corresponding to one of the twelve ⅝-in. rods fastened to the shoe. Through each hole the long threaded shank of a ⅝-in. eyebolt was thrust up, eye beneath the platform, and a nut run down on the threaded end projecting above the platform. A series of ⅝-in. rods, 3 ft. long and hooked at each end, was now hung from the eyebolts, and successive rods were hooked in, one below the other, until the lowest reached the hooks of the shoe rods. Then all nuts were tightened until the shoe, forms, and such part of the concrete as had already been poured were hanging from the platform, level and plumb. The planks that had prevented from sinking were then removed from under the cutting edge of the shoe.

Four 1½-in. holes were now bored through the platform for the four pieces of 1-in. wire rope, passing through plate washers. When they had been drawn taut, two clamps were put on each rope, so that the concrete cylinder could hang either from these four ropes or from the twelve eyebolts, or from both. Thus the five 8-in. rods, as well as the four 1-in. wire ropes, made up part of the re-enforcement. Further re-enforcement was afforded by two 25-ft. lengths of old wire rope for each form, each piece being coiled horizontally between the two forms, laced in and out between the verical rods and ropes, and tied to them by wires so spaced that there was such a horizontal coil of wire rope re-enforcement in the concrete every 18 in.

Two sets of the steel forms were used. When the concrete had set in the lower ones, the second set was bolted on top of the first through the matched bolt holes in the angle irons at the tops and bottoms of the forms. The two re-enforcing wire ropes were then laid and wired to the vertical re-enforcing hooked hanger rods. Next, the concrete was poured, a little at a time, being worked free of air bubbles and pockets by tamping it down with 6-ft. lengths of 1-in. pipe hammered flat at the end.

Twice during the building up of the caisson, when the sectional forms had been bolted together and into place, they did not form a true circle. On these occasions a clamp consisting of a ⅝-in. iron rod about 7 ft. long and threaded for about 12 in. on each end was used. The upper two inches of wood filler was cut out of the joints of the inner form in the two opposite joints nearest to the line of greatest diameter, and nuts were run down and screwed up so as to squeeze the inner form until the two diameters at right angles to each other were equal, the forms at the time of course being empty. The eccentricity was removed only at the top, as there would have been no "give" at the bottom. On the two occasions when the clamp had to be used, the eccentricity was slight.

Three to five days after the upper form was poured, and after the concrete had set in each case, the lower form was taken off. Eyebolts were set into the lower circular angle iron at the bottom of the segments so that the sections of the inner form could be raised up through the center of the form in place above; the segments of the outer form were handled in the same way.

Before pouring each successive ring, the upper side of the previous one would be roughened before putting the outer form in place. Then, just before we were ready to pour the concrete, a grout of equal portions of sand and cement mixed thin with water would be poured in to a depth of about 1 in. to bond the joint. In each ring were laid several pieces of 1-in. pipe, 8¾ in.

Steel shoe in place, with re-enforcing rods projecting

First set of forms in place with re-enforcing ropes

long, through which grout could be forced to the outside of the caisson, if this were found necessary to seal off the brine. At 12-ft. intervals four ¼-in. steel plates 6 in. wide and 18 in. long were set in the concrete 90 deg. apart, projecting out into the inside of the caisson. Each had a 1-in. hole bored in the projecting part. These were afterward used to carry timbers bolted to them to support a small platform for the 12-ft. ladders used in the shaft.

To provide a place to stand on while the inner form was being taken out and reset above, a circular wooden platform 5 ft. in diameter was lowered into the caisson, hung by long, hooked rods.

After several rings of concrete had hardened so that lowering of the caisson could be started, other pairs of clamps were put on the four 1-in. wire ropes 3 ft. back from those first placed. Then the latter were taken off and set 3 ft. behind the second. The nuts on the twelve eyebolts were next slacked off quickly and the caisson was allowed to sink until the clamps on the four ropes came up to the plate washers and stopped it; then twelve new 3-ft. hook rods were put in place and the eyebolts tightened again. By the means provided the whole structure could be made plumb again in case it canted.

When starting to sink, the caisson moved 3 or 4 in. per minute, but the rate became less later. All of the material within the caisson had to be removed completely. The shoe would not cut more than a few inches ahead of excavation, despite the softening of the ground by the heavy blast. The routine from then on consisted in removing the lower form, replacing it above, pouring the concrete for the new ring, excavating within the caisson, lowering the latter 3 ft. or the depth of one ring, and then repeating the sequence.

After seven 3-ft. rings of concrete had been lowered, the shoe entered the impervious shale bed and the caisson ceased to sink under its own weight. Continuous straight ⅝-in. iron rods were substituted for the 3-ft. re-enforcing rods and the caisson was built up until four rings, or 12 ft., stood above the surface. Brine was coming into the shaft below the shoe at so slow a rate that excavation could be carried on and well down into the shale by removing the seepage by bailing. The excavation was thus continued 12 ft. below the bottom of the shoe.

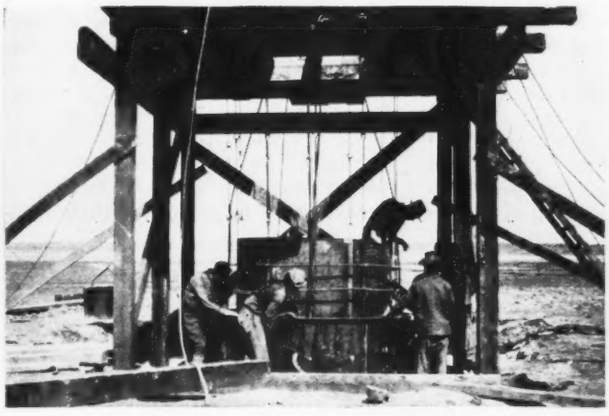
The platform was now taken off the supporting structure and the planks were laid across the top of the caisson itself, from which both sets of lower forms had been removed, the inner forms being left in place. On this flooring the two outside forms were assembled and piled full of waste from the dump, wetted and trodden down, until the forms were full and must have contained about 20 tons of material, besides the weight of the forms and the plank flooring. The concrete in the caisson, the re-enforcement, and the shoe must have weighed about 53 tons, so that a total weight of 73 to 75 tons was acting on the caisson to make it sink. Nevertheless it showed no tendency to move. Then, without the slightest warning, it dropped the whole 12 ft. so quickly that it was down with the top flush with the surface before anyone even realized that it had started to move, and the force of the fall drove the cutting shoe tightly into the impervious shale so that not a drop of brine seeped under it into the opening.

The rest of the platform was taken down. Excavation was made beneath the shoe, so that two 8x8-in. timbers could be set with 18 in. bearing beyond each side of the shaft. The actual opening was 5 ft. 4 in. square, these timbers being the bearers from which the shaft timbering was to be hung. A concrete seal was then poured into a box form resting on the timbers and of such height as to bring the concrete up a few inches above the top edge of the shoe. This completed the sinking of the caisson and the permanent sealing off of the upper brine.

Shaft sinking was continued by the methods customarily employed for small shafts, with 8x8-in. timbers and 6-ft. posts.

Hoisting was done with a standard diamond prospector's rig consisting of a derrick crane with a 30-ft. boom mounted on a narrow but long pivoted and balanced platform, the weight of the mast structure being balanced by a 7-hp. kerosene throttling engine, belt-connected to the hoist-drum gears, and further supported by two tubular struts reaching from the mast top down to the ground, where they were weighted down. These struts were at such an angle as to permit swinging the back end of the platform beneath them, the divergence between the two being about 90 deg. Thus the boom could swing laterally through an arc of nearly 270 deg. or until it was stopped by the two back struts. The swinging was accomplished by having a Kaffir boy push the back end of the platform. Thus the bucket, on reaching surface, could be hoisted into the air, crosshead and all, and be swung around and emptied on the dump without need of a car.

The black shale bearing the lower strong brine proved tough to break. The boys never quite mastered the technique of cut holes, so it took at least eleven 5-ft. holes to break a round for a shaft excavation 5 ft. 4 in. square. However, the 100-ft. shaft was completed in 93 days from the time of starting the churn-drill holes for the can-blast, exceeding my estimate by only three days, and costs were about $83 per foot. This covered the first cost of all equipment used, including the hoisting rig, forms, shoes, materials, and tools, there not having been so much as a pick and shovel on the job when it was started. The only man on the job that had ever done any mining before, besides myself, was a carpenter.



Platform over shaft. All work suspended by iron rods

Typical diamond prospector's hoisting rig

Composite-Pound Analyses

Values Based on Various Metals Produced

H. D. Keiser

Associate Editor

SUPPLEMENTAL to the tables of prorated costs that appeared in the May issue are the accompanying composite-pound analyses, which show the value of a composite pound of metal as produced by the various smelting and mining companies, as well as the dividends and bonded interest distributed by the companies per pound of this output. Percentages shown in the last column of these tables indicate the earnings based upon the value of the composite pound.

During the period 1922-1932, prices of the various metals, with the exception of gold, fluctuated widely, and the competitive position of certain companies undoubtedly varied with these prices. The period and the cycle covered by it are, however, probably of sufficient length to make any such temporary advantages ineffective, and to encourage the belief that the tables present a reasonably fair basis on which to compare the various companies.

Viewing the situation from the present, cognizance must be given to the abandonment of the gold standard by the United States, and the establishment of a domestic price for gold; this action has materially changed the earning power of many of the producers. Copper-producing companies, which hitherto marketed their produce as furnace-refined metal owing to its low content of the precious metals, may in the future market their output in the form of electrolytic copper. Thus, although they will not receive the full benefit of the advance in gold price, as a result of the additional cost involved in electrolytic refining, nevertheless their competitive position will probably be materially altered.

Generally speaking, gold has been and is a more important constituent of domestic copper ores than of either South American or African ores. On the other hand, the gold content of Canadian copper ores far outranks in importance that of United States copper ores. With the exception of the deposits in Peru of the Cerro de Pasco Copper Corporation, the silver content of copper ores has been of more importance to domestic producers than to South American, African, or Canadian operators.

In connection with the accompanying tables, one should bear in mind that the smelting companies are, in general, relieved of the investment required for mining; return on invested capital for such companies usually has to cover only smelting and refining. Consequently, the margin of profit per unit of product for these companies need not be as large as that required in the instance of a completely integrated organization, which must have earnings sufficient to cover capital investment in all of its various unit operations from mining to fabrication.

Any analysis employing the data presented in the tables must appraise each of the mentioned companies individually, as no two are alike in all respects. Bunker Hill & Sullivan, for instance, is integrated to the extent of smelting and refining the product from its own mines and concentrating plants, but it also engages in custom smelting and refining. Federal Mining & Smelting, however, which operates in the same field as Bunker Hill & Sullivan, does no smelting, this work being performed for it by its principal, American Smelting & Refining. In the instance of Hecla Mining, the smelting of its products is taken care of by Bunker Hill & Sullivan.

Only four companies in this country smelt lead ores. These are American Smelting & Refining; American Metal; U. S. Smelting, Refining & Mining; and Bunker Hill & Sullivan. American Smelting & Refining, for example, smelts and refines the greater part of the output of St. Joseph Lead. This procedure results in St. Joseph Lead having a relatively small investment so far as smelting and refining are concerned, most of its capital being used for mining and concentrating, whereas that of American Smelting & Refining is largely devoted to smelting and refining.

This is the third article in a series devoted to a study of production costs, consisting largely of tables prepared by the Minerals Division of the U. S. Bureau of Foreign and Domestic Commerce.

Composite-Pound Analysis of Some Foreign Copper-Mining Companies

Prepared by the Minerals Divisions, U. S. Bureau of Foreign and Domestic Commerce.
(Sources: Production data, American Bureau of Metal Statistics; financial data, Moody's Investors Service, and the Mines Handbook, by Rand and Sturgis)

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
ANDES COPPER (1927-1932 inclusive—1927 first year of production.)							
Copper	522,092,254	99.98811058	15.99809769	14.134	.....	.....	....
Silver	58,546	0.01121239	0.00179398	0.087	.....	.....	....
Gold	3,535	0.00067703	0.00010833	0.202	.....	.....	....
Total	522,154,335	100	16.0	14.423	3.143	11.280	21.8
CERRO DE PASCO (1922-1932 inclusive).							
Copper	903,666,000	80.56409246	12.89025472	10.675	.....	.....	....
Lead	123,042,000	10.96950205	1.75512048	0.671	.....	.....	....
Zinc	85,510,000	7.62352106	1.21976336	0.449	.....	.....	....
Silver	9,430,490	0.84075280	0.13452032	7.016	.....	.....	....
Gold	24,931	0.00213163	0.00034112	0.643	.....	.....	....
Total	1,121,673,421	100	16.0	19.454	3.799	15.655	19.9
CHILE COPPER (1922-1932 inclusive).							
Copper	2,207,995,082	100	16.0	13.559	.....	.....	....
Total	2,207,995,082	100	16.0	13.599	5.965	7.594	25.5

Composite-Pound Analysis of Some Foreign Copper-Mining Companies—*Continued*

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
GRANBY CONSOLIDATED (1922-1932 inclusive).							
Copper	490,416,158	99.93737245	15.98997959	13.134	.....	.....	....
Silver	301,102	0.06135879	0.00981740	0.491	.....	.....	....
Gold	6,226	0.00126876	0.00020301	0.393	.....	.....	....
Total	490,723,486	100	16.0	14.018	1.941	12.077	13.8
GREENE CANANEA (1922-1932 inclusive).							
Copper	388,909,021	99.91101113	15.98576178	13.087	.....	.....	....
Silver	341,821	0.08781406	0.01405025	0.737	.....	.....	....
Gold	4,573	0.00117481	0.00018797	0.354	.....	.....	....
Total	389,255,415	100	16.0	14.176	1.830	12.346	12.9
HUDSON BAY (1930-1932 inclusive.) (Began production in 1930.)							
Copper	75,598,781	48.33068647	7.73290983	3.306	.....	.....	....
Zinc	80,698,199	51.59077042	8.25452327	1.697	.....	.....	....
Silver	112,190	0.07172364	0.01147578	0.295	.....	.....	....
Gold	10,667	0.00681947	0.00109112	2.056	.....	.....	....
Total	156,419,837	100	16.0	7.354	0.432	6.922	5.9
INTERNATIONAL NICKEL AND MOND NICKEL (1926-1929 inclusive).							
Copper	252,298,294	41.18112674	6.58898028	6.334	.....	.....	....
Nickel	360,278,000	58.80600242	9.40896038	20.582	.....	.....	....
Silver	71,052	0.01159739	0.00185558	0.094	.....	.....	....
Gold	1,484	0.00024222	0.00003876	0.074	.....	.....	....
Platinum	6,318	0.00103123	0.00016500	1.267	.....	.....	....
Total	612,655,148	100	16.0	28.351	5 310	23.041	18.7
KENNECOTT (Braden and Alaska). (1922-1932 inclusive.)							
Copper	2,140,593,064	99.98985246	15.99837639	13.118	.....	.....	....
Silver	217,238	0.01014754	0.00162361	0.088	.....	.....	....
Total	2,140,810,302	100	16.0	13.206	4.345	8.861	32.9
NORANDA MINES, LTD. (1928-1932 inclusive). (Began production in 1928.)							
Copper	285,669,328	99.92814997	15.98850399	11.367	.....	.....	....
Silver	151,172	0.05288050	0.00846088	0.271	.....	.....	....
Gold	54,229	0.01896953	0.00303513	5.719	.....	.....	....
Total	285,874,729	100	16.0	17.357	2.838	14.519	16.4
KATANGA (1922-1932 inclusive).							
Copper	2,092,936,000	100	16.0	12.132	.....	.....	....
Total	2,092,936,000	100	16.0	12.132	1.926	10.206	15.9

Composite-Pound Analysis—Leading Copper-Mining Companies

Prepared by the Minerals Division, U. S. Bureau of Foreign and Domestic Commerce.
(Sources: Production data, American Bureau of Metal Statistics; financial data, Moody's Investors Service, and the Mines Handbook, by Rand and Sturgis)

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
ANACONDA COPPER (1922-1932 inclusive)							
Copper	2,186,072,000	49.85186751	7.97629880	6.705	.....	.....	....
Lead	191,241,352	4.36114742	0.69778359	0.305	.....	.....	....
Zinc	2,000,862,000	45.62848097	7.30055695	2.771	.....	.....	....
Silver	6,926,381	0.15795055	0.02527209	1.357	.....	.....	....
Gold	24,274	0.00055355	0.00008857	0.170	.....	.....	....
Total	4,385,126,007	100	16.0	11.308	3.625	7.683	32.0
CALUMET & ARIZONA (1922-1930 inclusive). (Consolidated with Phelps Dodge in 1931.)							
Copper	524,913,120	99.86711747	15.97873880	14.692	.....	.....	....
Silver	673,989	0.12822948	0.02051671	1.064	.....	.....	....
Gold	24,457	0.00465305	0.00074449	1.407	.....	.....	....
Total	525,611,566	100	16	17.163	5.607	11.556	32.7
CALUMET & HECLA (1923-1932 inclusive). (Began operations under this name in 1923.)							
Copper	854,742,000	100	16.0	13.521	.....	.....	....
Total	854,742,000	100	16.0	13.521	3.402	10.119	25.2
CHAMPION COPPER (1922-1930 inclusive). (Consolidated with Copper Range in 1931.)							
Copper	169,997,219	100	16.0	14.185	.....	.....	....
Total	169,997,219	100	16.0	14.185	3.718	10.467	32.6
COPPER RANGE (1) (1922-1932 inclusive).							
Copper	89,303,635	100	16.0	11.528	.....	.....	....
Total	89,303,635	100	16.0	11.528	5.799	5.729	50.3
INSPIRATION CONSOLIDATED (1922-1932 inclusive).							
Copper	840,991,039	100	16.0	12.990	.....	.....	....
Total	840,991,039	100	16.0	12.990	1.963	11.037	15.1
ISLE ROYAL COPPER (1922-1932 inclusive).							
Copper	95,875,217	100	16.0	13.673	.....	.....	....
Total	95,875,217	100	16.0	13.673	1.525	12.148	11.1
MAGMA COPPER (1922-1932 inclusive).							
Copper	274,061,188	99.79895835	15.96783334	13.635	.....	.....	....
Silver	545,888	0.19878427	0.03180548	1.485	.....	.....	....
Gold	6,199	0.00225738	0.00036118	0.680	.....	.....	....
Total	274,613,275	100	16.0	15.800	3.523	12.277	22.3
MIAMI COPPER (1922-1932 inclusive).							
Copper	594,407,603	100	16.0	13.375	.....	.....	....
Total	594,407,603	100	16.0	13.375	2.168	11.207	16.2
MOHAWK (1922-1932 inclusive).							
Copper	172,020,000	100	16.0	13.356	.....	.....	....
Total	172,020,000	100	16.0	13.356	3.213	10.143	24.1

Composite-Pound Analysis—Leading Copper-Mining Companies—*Continued*

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
MOTHER LODE COALITION (1922-1932 inclusive).							
Copper	215,016,860	99.94633344	15.99141335	13.560	.....	.....	....
Silver	115,452	0.05366656	0.00858665	0.478	.....	.....	....
Total	215,132,312	100	16.0	14.038	6.508	7.530	46.4
NEVADA CONSOLIDATED (1922-1932 inclusive). (Including Ray and Chino prior to 1926.)							
Copper	1,994,264,157	99.99434890	15.99909582	3.689	.....	.....	....
Silver	89,719	0.00449860	0.00071978	0.028	.....	.....	....
Gold	22,985	0.00115250	0.00018440	0.352	.....	.....	....
Total	1,994,376,861	100	16.0	14.069	2.425	11.644	17.2
NEW CORNELIA (1922-1928 inclusive). (Consolidated with Calumet & Arizona in 1929.)							
Copper	431,367,514	99.98320576	15.99731292	13.741	.....	.....	....
Silver	67,127	0.01555882	0.00248941	0.143	.....	.....	....
Gold	5,330	0.00123542	0.00019767	0.371	.....	.....	....
Total	431,439,971	100	16.0	14.255	3.797	10.458	26.6
OLD DOMINION (1922-1931 inclusive). (Not operating in 1932.)							
Copper	216,685,031	99.96192650	15.99390824	13.639	.....	.....	....
Silver	79,545	0.03669599	0.00587136	0.326	.....	.....	....
Gold	2,986	0.00137751	0.00022040	0.415	.....	.....	....
Total	216,767,562	100	16.0	14.380	Def.—1.617	15.997	....
PHELPS DODGE (1922-1932 inclusive).							
Copper	1,879,513,160	96.01078160	15.36172506	12.700	.....	.....	....
Lead	75,526,000	3.85807902	0.61729264	0.270	.....	.....	...
Zinc	610,709	0.03119672	0.00499148	0.002	.....	.....	....
Silver	1,923,474	0.09825642	0.01572102	0.743	.....	.....	....
Gold	33,010	0.00168624	0.00026980	0.518	.....	.....	....
Total	1,957,606,353	100	16.0	14.233	1.608	12.625	11.3
UTAH COPPER (1922-1932 inclusive).							
Copper	2,110,147,163	99.97459622	15.99593539	13.710	.....	.....	....
Silver	481,653	0.02281977	0.00365116	0.191	.....	.....	....
Gold	54,540	0.00258401	0.00041345	0.778	.....	.....	....
Total	2,110,683,356	100	16.0	14.679	5.349	9.330	36.4
UNITED VERDE (1922-1931 inclusive). (Closed down in 1932.)							
Copper	903,552,152	99.86834580	15.97893533	14.266	.....	.....	....
Silver	1,159,478	0.12815547	0.02050487	1.100	.....	.....	....
Gold	31,654	0.00349873	0.00055980	1.051	.....	.....	....
Total	904,743,284	100	16.0	16.417	4.244	12.173	25.9
UNITED VERDE EXTENSION (1922-1932 inclusive).							
Copper	460,696,000	99.94112855	15.99058057	13.339	.....	.....	....
Silver	264,321	0.05734050	0.00917448	0.455	.....	.....	....
Gold	7,057	0.00153095	0.00024495	0.461	.....	.....	....
Total	460,967,378	100	16.0	14.255	5.384	8.871	37.8

Total domestic companies' copper production, 14,013,625,058.
Total U. S. mine production of copper, 1922-32, 15,836,749,000.
Per cent of total, 88.5.

(1) The Copper Range Company up until 1931 owned a half interest in the Champion Copper Company, at which time it took over the latter in entirety. In the annual statements of the Copper Range, 50% of the Champion production is shown each year, and to obtain the actual production of Copper Range from 1922 to 1930, inclusive, this 50% of Champion production was deducted, as the Champion Copper Company is shown separately from 1922 to 1930, inclusive, after which latter year it is consolidated with the Copper Range Company.

Composite-Pound Analysis—Leading Refining and Smelting Companies

Prepared by the Minerals Division, U. S. Bureau of Foreign and Domestic Commerce
(Sources: Production data, American Bureau of Metal Statistics and U. S. Bureau of Mines; financial data, Moody's Investors Service and the Mines Handbook, by Rand and Sturgis)

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
AMERICAN METAL (1922-1932 inclusive).							
Copper	3,921,094,000	52.81427519	8.45028403	7.015	.....	.....	....
Lead	2,410,212,000	32.46379705	5.19420753	2.174	.....	.....	....
Zinc	1,065,096,000	14.34606598	2.29537056	0.896	.....	.....	....
Silver	27,618,678	0.37200344	0.05952055	2.963	.....	.....	....
Gold	286,451	0.00385834	0.00061733	1.163	.....	.....	....
Total	7,424,307,129	100	16.0	14.211	0.276	13.935	1.9
AMERICAN SMELTING & REFINING (1922-1932 inclusive).							
Copper	9,514,684,000	48.49264472	7.75882315	6.619	.....	.....	....
Lead	9,048,398,000	46.11616629	7.37858661	3.094	.....	.....	....
Zinc	995,928,000	5.07585777	0.81213724	0.288	.....	.....	....
Silver	60,657,279	0.30914657	0.04946345	2.518	.....	.....	....
Gold	1,213,480	0.00618464	0.00098955	1.870	.....	.....	....
Total	19,620,880,759	100	16.0	14.389	0.537	13.852	3.7
FEDERAL MINING & SMELTING (1922-1932 inclusive).							
Lead	809,322,000	53.23905447	8.51824872	3.651	.....	.....	....
Zinc	709,652,000	46.68253364	7.46920538	3.017	.....	.....	....
Silver	1,191,826	0.07840104	0.01254416	0.648	.....	.....	....
Gold	165	0.00001085	0.00000174	0.003	.....	.....	....
Total	1,520,165,991	100	16.0	7.319	0.566	6.753	7.7
UNITED STATES SMELTING, REFINING & MINING (1922-1932 inclusive).							
Copper	75,411,776	4.40318438	0.70450950	0.600	.....	.....	....
Lead	1,127,050,000	65.80681732	10.52909077	4.418	.....	.....	....
Zinc	491,624,000	28.70521340	4.59283414	1.662	.....	.....	....
Silver	18,402,095	1.07447167	0.17191547	8.392	.....	.....	....
Gold	176,631	0.01031323	0.00165012	3.109	.....	.....	....
Total	1,712,664,502	100	16.0	18.181	1.880	16.301	10.3

These smelting and refining companies represent the following percentages of base-metal smelter production in the United States, 1922-1932 inclusive: Copper 79.9%; lead, 93.9%; zinc, 30.3%.

Composite-Pound Analysis—Leading Lead-Zinc Mining Companies

Prepared by the Minerals Division, U. S. Bureau of Foreign and Domestic Commerce.
(Sources: Production data, American Bureau of Metal Statistics; financial data, Moody's Investors Service, and the Mines Handbook, by Rand and Sturgis)

	Production, Pounds	Production Percentages	Content, Ounces	Value, Cents	Dividend and Bond Interest per Pound, Cents	Cost per Pound, Cents	Per Cent of Profit per Pound
BINGHAM MINES (1922-1928 inclusive).							
Copper	5,499,000	5.31162114	0.84985938	0.734	.....	.....	....
Lead	93,040,000	89.86965471	14.37914475	6.617	.....	.....	....
Zinc	4,454,000	4.30222960	0.68835674	0.302	.....	.....	....
Silver	532,546	0.51439945	0.08230391	4.760	.....	.....	....
Gold	2,169	0.00209510	0.00033522	0.632	.....	.....	....
Total	103,527,715	100	16.0	13.045	0.693	12.352	5.3
BUNKER HILL & SULLIVAN (1922-1932 inclusive).							
Lead	908,220,000	95.08841013	15.21414563	6.123	.....	.....	....
Zinc	45,740,000	4.78886602	0.76621856	0.213	.....	.....	....
Silver	1,172,175	0.12272385	0.01963581	0.937	.....	.....	....
Total	955,132,175	100	16.0	7.273	2.338	4.935	32.1
BUTTE & SUPERIOR (1922-1930 inclusive).							
Copper	47,140,000	6.91773896	1.10683823	0.953	.....	.....	....
Lead	65,866,000	9.66575719	1.54652115	0.709	.....	.....	....
Zinc	567,336,000	83.25588346	13.32094136	5.359	.....	.....	....
Silver	1,094,431	0.16060645	0.02569703	1.375	.....	.....	....
Gold	95	0.00001394	0.00000223	0.042	.....	.....	....
Total	681,436,526	100	16.0	8.438	0.490	7.948	5.8
CALLAHAN ZINC-LEAD (1922-1932 inclusive).							
Lead	23,040,000	46.93897479	7.51023597	3.202	.....	.....	....
Zinc	25,992,000	52.95303094	8.47248495	3.450	.....	.....	....
Silver	53,009	0.10799427	0.01727908	0.899	.....	.....	....
Total	49,085,009	100	16.0	7.551	Def.—1.818	9.369	....
CHIEF CONSOLIDATED (1922-1932 inclusive).							
Copper	8,508,000	4.04777773	0.64764444	0.562	.....	.....	....
Lead	178,218,000	84.78923963	13.56627834	6.222	.....	.....	....
Zinc	21,918,000	10.42773768	1.66843803	0.730	.....	.....	....
Silver	1,537,735	0.73159492	0.11705519	6.599	.....	.....	....
Gold	7,672	0.00365004	0.00058400	1.094	.....	.....	....
Total	210,189,407	100	16.0	15.207	1.016	14.191	6.7
DAYROCK MINING (1923-1930 inclusive).							
Lead	25,404,000	99.79012019	15.96641923	6.504	.....	.....	....
Silver	53,430	0.20987981	0.03358077	1.656	.....	.....	....
Total	25,457,430	100	16.0	8.160	0.998	7.162	12.2
HECLA MINING (1922-1932 inclusive).							
Lead	542,578,000	98.89517325	15.82322777	6.499	.....	.....	....
Zinc	4,118,201	0.75062056	0.12009929	0.040	.....	.....	....
Silver	1,943,315	0.35420619	0.05667294	1.504	.....	.....	....
Total	548,639,516	100	16.0	8.043	2.041	6.002	25.4
NORTH LILY MINING (1928-1932 inclusive).							
Lead	77,050,000	98.69477616	15.79116738	6.179	.....	.....	....
Zinc	870,960	1.11562906	0.17850065	0.062	.....	.....	....
Silver	144,594	0.18521318	0.02963411	1.353	.....	.....	....
Gold	3,405	0.00436160	0.00069786	1.309	.....	.....	....
Total	78,068,959	100	16.0	8.903	1.376	7.527	15.5
PARK UTAH CONSOLIDATED (1922-1932 inclusive).							
Copper	13,347,366	2.23943563	0.35830970	0.313	.....	.....	....
Lead	310,934,000	52.16884575	8.34701532	3.695	.....	.....	....
Zinc	269,589,000	45.23193654	7.23710985	2.845	.....	.....	....
Silver	2,132,462	0.35778680	0.05724589	3.150	.....	.....	....
Gold	11,892	0.00199528	0.00031924	0.601	.....	.....	....
Total	596,014,720	100	16.0	10.604	1.321	9.283	12.5
ST. JOSEPH LEAD (1922-1932 inclusive).							
Lead	3,203,684,000	87.77351100	14.04376176	5.826	.....	.....	....
Zinc	446,260,000	12.22648900	1.95623824	0.646	.....	.....	....
Total	3,649,944,000	100	16.0	6.472	1.459	5.013	22.5
SILVER KING COALITION (1922-1932 inclusive).							
Copper	12,907,278	2.82896209	0.45263393	0.376	.....	.....	....
Lead	364,492,000	79.88780058	12.78204809	5.345	.....	.....	....
Zinc	77,239,000	16.92891429	2.70862629	0.953	.....	.....	....
Silver	1,614,445	0.35384716	0.05661555	2.812	.....	.....	....
Gold	2,171	0.00047588	0.00007614	0.144	.....	.....	....
Total	456,254,894	100	16.0	9.630	2.136	7.494	22.2
TINTIC STANDARD (1922-1932 inclusive).							
Copper	9,441,369	2.26887416	0.36301987	0.288	.....	.....	....
Lead	404,378,000	97.17688129	15.54830101	6.750	.....	.....	....
Silver	2,293,662	0.55119447	0.08819111	4.559	.....	.....	....
Gold	12,692	0.00305008	0.00048801	0.927	.....	.....	....
Total	416,125,723	100	16.0	12.524	3.760	8.764	30.0
UTAH APEX MINING (1922-1932 inclusive).							
Copper	35,498,000	9.67962252	1.54873960	1.351	.....	.....	....
Lead	232,780,000	63.47516222	10.15602596	4.672	.....	.....	....
Zinc	98,126,000	26.75726823	4.28116292	1.766	.....	.....	....
Silver	319,017	0.08699044	0.01391847	0.751	.....	.....	....
Gold	3,508	0.00095659	0.00015305	0.291	.....	.....	....
Total	366,726,525	100	16.0	8.831	0.612	8.219	6.9

The above mining companies represent the following percentages of recoverable lead and zinc mined in the United States, 1922-1932: Lead, 52.0%; zinc, 11.8%. New Jersey Zinc not shown, due to the fact that sufficient data concerning this company are not available.

NEWS OF THE INDUSTRY

Silver Purchase Act of 1934 Signed by the President

New Legislation "Authorizes and Directs" Buying of Silver Until It Constitutes 25 Per Cent of the Nation's Monetary Stocks—Issuance of Silver Certificates To Be Based on Cost Price of Metal—Embargo Established.

President Roosevelt signed the Silver Purchase Act of 1934 on June 19, the bill having been passed by the Senate on June 11 and by the House on May 31. The legislation, which declares it to be the policy of the United States "that the proportion of silver to gold in the monetary stocks of the United States should be increased, with the ultimate objective of having and maintaining one-fourth of the monetary value of such stocks in silver," was signed in the President's study in the Executive Mansion with considerable formality in the presence of members of the silver bloc. Among those present were Senators Borah, Adams, King, McCarran, Smith, Shipstead, Pittman, and Wheeler, and Representative White, of Idaho.

The principal provisions of the legislation are:

1. Authorizes and directs the Secretary of the Treasury to buy silver at home and abroad at such rates, times and terms as he deems reasonable and most advantageous to the public interest. Such purchases not to be made at a price in excess of the monetary value, and in the case of silver in the United States at a price of not more than 50c. a fine ounce.

2. Authorizes the Secretary of the Treasury, with approval of the President, to sell silver acquired under the terms of the act whenever the market price exceeds the monetary value, whenever the government stocks are more than 25 per cent of the monetary stocks of gold and silver; provided the sales do not reduce the silver required as security for outstanding silver certificates.

3. Authorizes and directs the Secretary of the Treasury to issue silver certificates in such denominations as he may prescribe, the face value of the certificates to be not less than the cost of all the silver bought under the terms of the act. Makes all silver certificates legal tender and redeemable on demand of the Treasury in standard silver dollars.

4. Vests in the Secretary of the Treasury, with approval of the President, power to investigate, regulate or prohibit the acquisition, importation, exportation or transportation of silver and to require reports as to the facts involved. This authority can be exercised only when necessary to effectuate the policy of the law. Violations of licenses, orders, rules and regulations issued under this provision are made criminal offenses.

5. Authorizes the President, by executive order, to require the delivery of silver to the mints regardless of who the owner or holder of the metal may be or where the silver may be situated. Silver withheld in violation of this provision to be forfeited to the government and the person withholding the metal to be subject to a penalty equal to twice the monetary value of the silver. This is the anti-hoarding clause.

6. Amends the stamp act provisions of existing law to provide a transfer tax on silver equal to 50 per cent of the difference between the cost to the transferer, plus allowed expenses and the price received.

The Treasury, according to a quoted statement made by Secretary Morgenthau late last month, will carry out "enthusiastically" the policy written into the Silver Purchase Act, and will buy at home and abroad when the metal is offered at a reasonable price. "What we want is a rise in the price of silver, but we don't want a sensational price rise, because the worst thing that could happen would be to have silver go up and then have a collapse," he said.

Purchases of silver have been made by the Treasury out of the general fund, as provided by the Act, since June 20, according to Secretary Morgenthau. The present policy of the Treasury will be to issue silver certificates only in the amount spent out of the general fund in acquiring the metal. Thus if 1,000 oz. are acquired at 50c. an ounce, $500 in silver certificates will be issued.

Surface plant at the portal of the Mayflower tunnel of New Park Mines, one of the more recent ventures in the East Park City district of Utah, formed by a merger of the Star of Utah, Park Bingham, and Mayflower companies. A promising body of ore is said to have been opened up by the company, and current operations in the Mayflower tunnel are expected to encounter an extension of the orebody formerly mined in the Park Bingham ground

The monetary value of silver as fixed by statute is $1.29 an ounce, and it would, therefore, be possible for the Treasury to issue a maximum of $1,290 in certificates against 1,000 oz., even though only 50c. an ounce actually was paid for this silver.

An order establishing an embargo on exports of silver, except those intended for legitimate purposes, which may be shipped under license, was issued by the Secretary of the Treasury on June 28. Speculative interests, according to reports, had made arrangements to ship abroad metal that was part of the stock held in the United States on May 1, their objective being to obtain the benefit of any advance above 50c. an ounce in the price of the metal.

High Tin Prices Reopen Old Cornwall Mines

The high price of tin is causing an awakening of activities in Cornwall, England. Wheal Breage Tin has been formed to acquire from Wheal Reeth Tin the tin and other mineral rights over an area of 110 acres in the Great Work area of Cornwall. Funds for development and equipment have been raised. A part of the property was worked productively prior to 1850, but the greater portion is virgin. Equipment is to be installed with which to sink below the old workings, and while the veins in that area are being developed, drives will be extended into the hitherto unexplored section.

Gold-Mining Operations Increase In Old and New Areas

FURTHER expansion of gold-mining operations in various parts of the United States was apparently the outstanding feature of developments last month in the mining industry in this country. The increased gold activity prevailed in both old and new areas, and involved a substantial amount of mill construction. Employer-employee relations were the subject of discussion in several districts, and in Utah operators and workers opened a series of conferences on collective bargaining.

A summary of the more important news of the month from the various mining districts follows.

Utah

Operators and employees of Utah mines have opened a series of conferences relating to collective bargaining as guaranteed under clause 7a of the NRA. Employees are asking for a $35 a week minimum weekly wage, a six-hour day, the right to select their own medical attendants, and other benefits.

Several weeks ago, the officials of the International Mine, Mill, and Smelter Workers' Union asked the Utah Chapter of the American Mining Congress to appoint a committee of operators to discuss collective bargaining, but the chapter replied that it had no power to act in this field. A number of sections of the union voted favoring a strike, but officials decided to try first to work out a peaceful settlement of difficulties.

Ore, carrying gold and silver, has been encountered in No. 1 Apex Standard shaft of Chief Consolidated Mining, near Eureka. The ore occurs in the lower member of the Ophir formation, at its contact with a steeply dipping bed of Cambrian quartzite. The discovery is about 800 ft. northeast of the Eureka Standard orebody, the only gold producer in the Tintic district. Another old Utah gold camp came to life this month, when W. F. Snyder & Sons, of Salt Lake City, started preparations to reopen the mines formerly operated at Mercur by the Dern interests. This step followed the closing of a deal whereby Lewiston Peak Mining, organized and financed by the Synder interests, acquired by purchase the Consolidated Mercur Mining property from Secretary of War George H. Dern and his associates for a price involving $375,000.

The Electric and Resolute tunnels are to be reopened, according to George W. Snyder, president of the new company, and a shaft will be sunk to develop the sulphide area of the Golden Gate unit below water level. To do this, the shaft will be put down in the gulch southeast of the old mill. At the time the property was shut down, according to an estimate of Secretary of War Dern, the mine contained about 1,000,000 tons of ore, averaging about $3.50 a ton at the former price of gold, or about $6 a ton at the present price. Several million tons of tailing on the property average about 0.05 oz. gold to the ton.

For a year and a half the Snyder interests have been conducting examinations of the property. At the same time, they have been operating the Manning mill, five miles south of Mercur, where tailing is being treated at the rate of 500 tons daily. Development of the Mercur property will probably involve the erection of another mill in the old camp, but considerable underground work and metallurgical tests must be completed before final plans can be adopted.

No. 406 winze being sunk in the East Crescent vein from the 400 level in the Park City Consolidated Mining property, at Park City, has reached a depth of 550 ft. The 800 level station has been cut preparatory to sinking another 150 ft. to the 900 level. Width of the vein is 18 ft.

Placer mining operations have been begun by Utah-Colorado Gold Mining on the Colorado River, three miles above Moab, on the Rio Colorado placer claims.

Numerous leasers are operating in the Ophir, Dry Canyon, and West Dip districts, southwest of Salt Lake City. From ten to fifteen car loads of ore a month are being shipped from the old Ophir Hill property, which is under bond and lease to International Smelting. Other properties shipping are the Fisk Ophir, the Lion Hill, the Hidden Treasure, the Buckhorn, the Queen of the Hills, the Kearsarge, and the Commodore.

Operations are being conducted in several headings in the Alta Champion property, in the Alta district, Little Cottonwood Canyon, 25 miles southeast of Salt Lake City. Exploration is being done from the Dwyer tunnel in the Wedge and Blue Bell fissures. Leasers are shipping from the Columbus Rexall, Flagstaff, West Toledo, and Wasatch mines.

Diamond drilling is being done by J. A. Van Evera and associates on a group of claims in the South Tintic district.

California

Substantial activity prevails in the area east of Roseville, Placer County, better known as the Allen district. The gold placer dredge completed recently by Frank Chenowith is working a broad belt of productive ground extending along an ancient river channel and covering about 900 acres, and another dredge is being erected by the Hill-Con. Steamship Company on the Laird

World Production of Silver

(*American Bureau of Metal Statistics*)

In Fine Ounces

	March	April	May
United States...	2,791,000	2,389,000	2,303,000
Canada.....	1,085,000	1,015,000	1,543,000
Mexico.....	4,495,000	7,822,000	(*f*) 6,000,000
Peru.....	548,000	517,000	659,000
Other America..	900,000	900,000	920,000
Europe.....	1,350,000	1,360,000	[1,360,000
Australia, refined	829,000	735,000	637,000
Other Australia & New Zealand	240,000	250,000	(*f*) 260,000
Burma, refined..	490,000	490,000	490,000
Other Asia.....	725,000	720,000	730,000
South Africa....	80,000	80,000	(*f*) 80,000
Other Africa....	40,000	40,000	(*f*) 40,000
Totals.....	13,573,000	16,318,000	15,022,000

For some of the countries the accounting, especially for the latest month, is preliminary and subject to revision which may be considerable. The Mexican returns, which arrive late, are difficult to estimate, owing to their irregularity. (*f*) Conjectural.

ranch southeast of Loomis. This territory is traversed by the Laird and Lee channels, and tests indicate that the deposits carry satisfactory quantities of gold.

Cardinal Gold Mining, which recently lost its mill by fire, has let a contract for building a 150-ton mill to Eastern Iron & Metal, of Salt Lake City, Utah, according to reports received from Bishop.

Idaho Maryland Mining, Grass Valley, granted an increase in wages of 50c. per day to all employees, pending completion of a profit-sharing plan which the management will present to the workers to vote upon.

Discovery of a new vein on the 1,000-ft. level of the Empress mine, in the Nevada City mining district, has been announced by E. C. Jacobs, general manager, Empress Mining. The find is said to add materially to ore reserves in the mine.

The old Landecker mine, near Placerville, has been taken under lease and option by Stillwagon Mining, and preliminary work started under the direction of D. Badger.

Kelsey Mining, operating the Lost mine, near Kelsey, has completed the installation of a Williamson ball mill and a flotation plant. The mine is controlled by San Francisco and Los Angeles interests.

Central Eureka Mining, at Sutter Creek, is arranging to sink the old Eureka shaft another 60 ft., to seek the downward continuation of the orebody discovered recently on the 2,300-ft. level. The mill is operating at full capacity. James Spiers is general manager.

Keeler Gold Mines has completed the construction of a power line, erection of a gallows frame, and the installing of necessary mining equipment preparatory to carrying on work in the double-compartment shaft at the Kreuger mine, 7 miles east of Keeler, Calif. The shaft is to be sunk from the present 125-ft. level to a depth of 250 ft., where further development will be carried on. Current operations are under the supervision of Thomas L. Chapman, mining engineer, president of the company.

Arizona

The widespread activity in precious-metal mining in Arizona is reflected in the large number of small concentrators which have been placed in operation recently, are being constructed, or whose construction is being planned. Some of these mills are reconditioned plants; some are new construction. Most of them are on individual properties, but quite a few are custom plants.

Thomas Sayer is planning to build a small mill for the Lola mine, at the Alamo crossing of the Bill Williams River, south of Kingman. At Oatman, Vivian Mining is planning a 70-ton mill. Material is being assembled at Chloride for the erection of a mill at the Pilgrim mine. Production from the Tyro group, 30 miles west of Kingman, near the Colorado River, has been going to the Katherine mill, operated by Gold Standard Mining. If exploration shows that this group has sufficient ore reserves, a 75-ton mill will be erected. Mill machinery is being hauled to the Golden Turkey mine, at Cleator, where a 50-ton flotation plant is being erected. Amulet Operating Company, in addition to erecting a 50-ton mill at its property at Walker, is reconditioning the shaft, erecting a headframe, and installing compressor equipment. Elmer Williams is building a small mill on the Boone group at Cherry, east of Prescott.

Ajo Papago Gold Mining, at Ajo, is about ready to accept custom ores at its 50-ton mill and cyanide plant. In the same district, P. C. Branch is erecting a mill at the Hadsell-Branch group of claims. D. L. Forrester, formerly mill superintendent for Old Dominion Mining at Globe, is operating the Harrisburg mill, near Salome, as a custom plant. Some of the properties in the Salome district which are shipping to this mill are the Bonanza claim of the old Harqua Hala, Golden Eagle, Harqua Hala Gold Mining, Gold Dome, Alaskan, Crago Gold, and the Harqua Hala Northern.

Wellton Mining & Milling, whose property is 6 miles south of Wellton, is treating high-grade ore in its 25-ton-capacity cyanide mill. In the mine, a 230-ft. shaft has been sunk on the vein and stoping is in progress on the 100-ft. level. Fargo F. Rose is general manager, and John B. Kasey is mill superintendent. The main operating difficulty is lack of water, which must be purchased at a cost of half a cent a gallon.

At the annual meeting of Tom Reed Gold Mines, held in Oatman the latter part of May, the following tonnages were reported to have been treated in the mill since operations were resumed on Feb. 13: From the Ben Harrison lease, 254.80 tons; from the Black Eagle lease, 1,569.18 tons; from the United American mine, 3,019.56 tons; from Tom Reed lessees, 1,574.67 tons; and from outside custom ores, 1,570.91 tons. The ore handled had a total value of $79,697.99, the average value per ton being $9.89. During the past year the workings were unwatered and a total of 3,170 ft. of development work was done. Most of the work was done in Argo ground. Two dewatering tanks have been added to the mill to increase its capacity.

The 1,200-acre Forbach and Easton placer property at Kirkland has been leased to John Irwin, of Milwaukee, who plans to recondition the plant and increase its capacity. Present equipment includes a small gasoline shovel, trommel, four Deister tables, and a pan amalgamator. The property has been idle for over a year.

In the southern part of the State, employment has been increasing. At the Douglas smelter, 40 men have been employed on account of the reopening of the acid plant, and operation of a second reverberatory furnace has given employment to 60 more. At Ajo, 750 men are on the New Cornelia payroll, where production is scheduled for July. The Tombstone district shipped 26 cars of silver ore in April, principally from Tombstone Extension.

Nevada

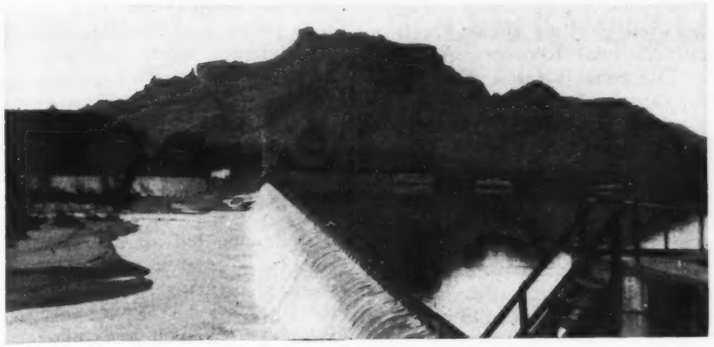
Two 8x8-ft. tunnel headings are being driven at the Como Mines property, at Como, 15 miles south of the Comstock. The two laterals are extensions of the Boyle tunnel branching at a point 3,500 ft. from the portal and designed to cut the Como and Rapidan veins at a depth of about 600 ft. In one day recently, the Como heading was advanced 21 ft. At each face the drills are mounted on a "jumbo" or heavy truck with 3-in. pipe columns, hinged at the base and supported by hinged I-beams from the rear end. Electric mucking machines load the muck to 3-cu.yd. side-dump cars in trains, drawn by storage-battery locomotives. Surface equipment is complete and includes battery-charging plant, machine shops, two compressors, and adequate mine and camp buildings. Charles Oster, president, is in charge; William Mader is superintendent, and Carl Stoddard consulting engineer. Blocked out ore reserves exceed 300,000 tons in shaft workings above a depth of 350 ft.

After a shutdown to install new ball-mill liners, the 75-ton cyanide mill of Gold Circle Consolidated is treating high-grade gold ore from the south shoot in the Elko Prince mine. A substantial block of ore remains in this property between the 750 and 900-ft. levels, the latter level recently having been unwatered. The mill is equipped with a sampler, and will receive ore from the J. E. Knapp lease on the Colorado Grande mine, owned also by Gold Circle Consolidated. This lease has a long oreshoot opened by pits, trenches, and a shaft, down 55 ft. on the vein. The shaft is reported to be in high-grade ore, 4½ ft. wide with a seam of high-grade ore on the hanging wall. The vein has produced some of the richest gold ore found in this region.

The Eastern Star mine, at Gold Circle, also a producer of high-grade gold ore, has been sold by N. H. Getchell, manager of Gold Circle Consolidated, to Samson D. Lee, of Boston, and associates. The mine is well equipped and the vertical shaft will be sunk from 210 to 320 ft. without delay.

Capacity of the flotation mill of Arizona-Comstock Corporation, operating the "middle" group of four old-time bonanza mines on the Comstock Lode, has been increased from 140 to 350

Central and Local Generation of Power For Arizona Mining Operations



Above—Granite Reef diversion dam in the Salt River, near Phoenix, Ariz. This stream is a source of power for the Miami, Inspiration, and Magma mines, the power being generated at a series of dams above the diversion dams. Below—Hall shaft on the property of the Ace Mining & Development Company, 10 miles south of Phoenix. An 8-hp. Sears Roebuck gasoline engine furnishes power for the hoist

tons and is treating 240 tons per day of surface ore mined by power shovel from the lode outcrop. W. J. Loring, president and directing engineer, says that this open-cut operation has proved successful far beyond expectations, the ore, although still diluted by overburden and surface debris, having maintained a high average value. Under capacity operation he believes combined mining, transportation, and milling costs can be brought down to $1.50 per ton. The shovel cut is 200 ft. long and 41 ft. wide and has not reached the central and more solid part of the outcrop, which is over 200 ft. wide at this point. On a 240-ton basis the mill is making 2½ tons of concentrate per day. This product is shipped by truck directly to the Selby smelter, on San Francisco Bay.

Nevada Porphyry Gold Mines, owning the lode and placer mines at Round Mountain, Nye County, is installing a gravel-washing plant of design said to be unique in this country. Its use will replace the hydraulic and sluicing methods employed in the uncertain and often brief periods when water has been available. The gravel will be loaded from banks by power shovel to 5-yd. cars, which will be drawn by a double-drum mine hoist up a long incline to a trestle, the cars dumping to a revolving trommel, the coarse barren rock falling to a movable conveyor and passing to waste piles. The fines and sand drop to the washing device for further separation and amalgamation. The lode mines are producing from a depth of 1,200 ft., and the cyanide mill is treating 200 tons per day.

Having expended $50,000 in enlarging and improving its plant, Bradshaw, Inc., is treating 1,400 tons daily of tailing from the old 1,000-ton Goldfield Consolidated cyanide mill. Mark Bradshaw, president and manager, had decided to abandon the project with the close of last year's operation, after seven years in which he had treated material averaging $1.67 gold per ton. A larger accumulation remained, however, that sampled 87c. per ton at the former price for gold, and this is said to offer a profitable operation over a period of several years. Bradshaw, Inc., following tests by Albert Silver, metallurgist, has undertaken the treatment of about 2,000,000 tons of tailing from the dismantled cyanide mill of Tonopah Mining, at Millers, 15 miles west of Tonopah. This plant, to cost around $75,000, is under construction and expected to be operating in September.

Stone Cabin Consolidated has completed construction of a 200-ton flotation mill at the portal of its Pony Meadows tunnel and will soon be on regular production. The mine, with estimated ore reserves of 600,000 tons above its winze level, is in the northern part of the Como district, near Dayton, Lyon County. Mill equipment includes crusher, rolls, ball mill, amalgamation plates, and flotation unit. Bulk tests on ore from various mine workings were conducted for several months in a pilot flotation mill, with results that were reported by Frank W. Royer, advisory engineer, to be satisfactory. Ore will be drawn at first from a 125,000-ton block above the level of the haulage tunnel, and development will proceed on deeper levels as the main winze is sunk in the orebody, which is 207 ft. wide at the winze level, 125 ft. below the main adit. Mine workings will supply all water needed for milling.

Activity near Silver City, at the lower end of the Comstock district, continues to increase. The Emma Nevada mine, an early producer of high-grade ore, and idle for 50 years, is being reopened by Lloyd H. Baker and associates, who have an option from Mrs. S. Ninnis, one of the Comstock pioneers. A shoot exposed in both upper and lower tunnels contains, for a length of 65 ft., a 6-in. seam of high-grade ore. Equipment and an ore bin have been provided, and the product is trucked 3,000 ft. to the Trimble custom mill in Gold Canyon.

High-grade gold ore is being hauled at the rate of 25 tons per day from the Keystone mine, above Silver City, to the Trimble mill. E. A. Montgomery, who opened the Montgomery-Shoshone mine, near Rhyolite, many years ago, took over the Keystone property last year. He opened ore nearly at the surface, and has developed ore to a depth of 250 ft. His company, Comstock Keystone, has lately acquired a dominant interest in the Justice mine, adjoining the Keystone on the south, and workings of the Justice, once a notable producer, are being reopened.

Thomas Wilson and John Smith are operating at Tenabo. Ore is being mined from the "Glory Hole," productive of some ore in the past. Plans are being made to erect a new mill to supplant the old one on the property. Fifteen men are employed.

Michigan

Gold deposits exist in the Upper Peninsula of Michigan that, in the opinion of the geological department of the State, can be mined at a profit. For 80 years geologists have known that gold ore was to be found "north of the Straits." Veins were discovered that produced gold for a time at a profit, but eventually the companies that mined it closed down and suspended operations. General belief is that the

failure of these attempts resulted principally from the inefficiency of methods employed and the type of machinery available at the time the mines were worked. With improved methods, gold may possibly be obtained in quantities that would more than pay for the cost of operations.

Ropes Gold & Silver, the first concern of its kind in Michigan, started milling operations three miles northeast of Ishpeming in 1882, and during its activity produced more than $600,000 in gross value of bullion. Michigan Gold Mining, whose property was situated near Ishpeming, obtained some of the finest specimens of free gold ever produced in this State. Now, after 40 years of inactivity, Michigan Gold Mining has resumed operations, with modern methods and equipment. The first shipment of gold was made recently. It consisted of 18 oz., valued at $500.

Minnesota

As previously predicted, shipment of iron ore from Lake Superior for May exceeded last year's shipments in April and May by almost 200 per cent, the total being 2,630,578 tons. June shipments will also be heavy. Ore operators are apparently playing safe and stocking heavily in preparation for a strike even if one does not materialize. No labor troubles can be observed on the Mesabi range. Agitators for the Amalgamated association have formed small union units, but these are composed mostly of workmen without jobs. All mine employers have followed the employees' representation plan and all the workers seem satisfied with this arrangement.

Announcement has been made that the summer meeting of the Lake Superior Mining Institute has been deferred until 1935.

Aluminum Code Approved for Trial Period

A code for the aluminum industry was approved on June 26 by Hugh S. Johnson, National Recovery Administrator. The code is for a trial period of 90 days. It became effective July 11, but the order says " . . . in view of the objections which have been made to said code and which have received due and careful consideration, it is in the public interest . . . to put said code into effect for a period of 90 days, in order to determine the extent to which said code will aid to promote the policy and purposes of Title I of the National Industrial Recovery Act, with the pertinent provisions of which Act I find that said code complies . . ."

Accordingly the code is ordered "to continue in effect for said trial period of 90 days, subject, however, to the right reserved in the Administrator to cancel or modify this order of approval at any time and subject further to the following conditions:

"The Administrator will cause an investigation to be made during said 90-day period of the past practices of the industry, and any modification of such practices or effect upon such practices resulting from the provisions of the code and a report made to the Administrator at least ten days prior to the expiration of said trial period, in order that he may determine the extent to which the code has operated to protect small enterprises from any alleged oppression or discrimination and has aided to effectuate the policy of said title of said Act, and the Administrator will request the aid of any other appropriate agencies of government in the making of such investigation and report.

"During said 90-day period the Administrator will receive and investigate any complaints of unfair competition in the sale of fabricated products at prices constituting unfair competition, or oppressing small enterprises, or tending toward monopoly, or the impairment of code wages and working conditions."

Maximum hours are prescribed as forty per week, with a normal work day of eight hours, but there are various exceptions.

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Broad Program of Tin Research Started in United States

Following out an extensive and continuous research program in the world's principal tin-using countries, the International Tin Research and Development Council has announced definite plans for carrying on this work in the United States.

On the recommendation of D. J. Macnaughtan, director of research for the International Council, the Battelle Memorial Institute, Columbus, Ohio, has been appointed to conduct research projects on tin in this country. Work is reported to be well under way, following such lines of investigation as will be of the greatest value to American manufacturers who employ tin for various purposes.

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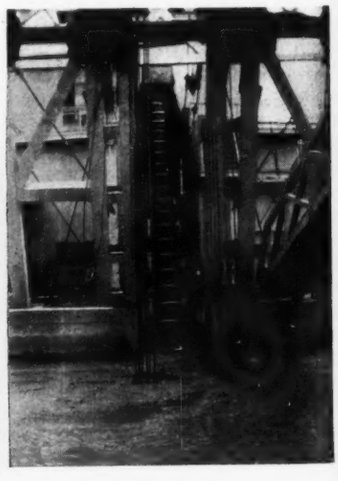
Lead Industry Elects Members of Code Authority

The industry members of the code authority for the lead industry, as elected according to the provisions of the Code of Fair Competition for the Lead Industry, and as approved by the Administrator, are as follows: Clinton H. Crane, chairman; F. H. Brownell, vice-chairman; F. M. Carter, vice-chairman; James F. McCarthy, F. Y. Robertson, G. W. Lambourne, John A. McCarthy, R. M. Roosevelt, P. E. Sprague, W. Y. C. Hunt; F. E. Wormser, secretary and treasurer.

Dredge of Gold Creek Mining Company, which is handling about 7,000 cu.yd. of ground a day along Gold Creek near the old Pioneer camp in Powell County, Mont.

The Pioneer area was the scene of one of the first gold discoveries in the State. To the right is a view of the elevator of the dredge



NEWS FROM WASHINGTON

By Special Correspondent

MINERAL POLICY making is one of the important phases of Washington activity today. The closing of the Congressional session terminates only one phase of this activity. Presidential decisions on many questions are still to come. Departmental activities in many new directions must be expected.

Some Washington observers think that even more important decisions will be reached in the next six months, because of the tremendous sweep of Executive authority, than have been fixed by Congressional enactments. One must accept this conclusion as a possibility because tariffs, production control, labor adjustment, and fiscal and monetary policy remain for Presidential action.

Mineral Policy Organization

Definite organization has been accomplished by the Planning Committee for Mineral Policy, established by President Roosevelt a few months ago (*E. & M. J.*, May, 1934, p. 229). C. K. Leith has been selected by the committee as its vice-chairman, and W. P. Rawles engaged as secretary. Offices have been opened in the Interior Building, to be close to Chairman Ickes' headquarters. Subcommittees have been named for the more important mineral commodities—ferrous metals, non-ferrous metals, petroleum, coal. One functional subcommittee will deal with international trade relations. That committee and the one handling copper promise to be most aggressively busy because of the urgency of the problems which they attack. J. W. Furness is chairman of each of these groups.

Free Ports

Mineral and other commodities may come into zones free of tariff duty, where they may be stored, broken up, repackaged, "or otherwise manipulated" without payment of duty. This is a new provision enacted by Congress in a law passed on June 18, one of the last few measures receiving Congressional approval. Proponents of this bill argued for the tpermission also to manufacture and exhibit goods while in these free zones, but those privileges were explicitly forbidden in the act as finally passed and approved by the President. Hence, mineral and metal industries expecting to consider relocation of operations of that character are not benefited by the new law.

Proponents of this kind of a measure believe that the next Congress may be more generous. They argue that manufacturing, processing, refining, and like treatment of goods should be permitted in order to give domestic employment. The opponents, of course, are those who represent territory which might thereby lose business to the coastal areas immediately around ports of entry. The nose of the camel has entered the tent; the industries worried by this will do well to watch that the neck and body do not follow next year.

Tariff Changes

Inasmuch as tariff flexibility does not now depend on a demonstration of difference in cost here and abroad, the freedom for action is increased. Expectations are, however, that the President will not undertake mineral tariff adjustments without awaiting careful advice, and that he may depend for it on the Planning Committee for Mineral Policy rather than the Tariff Commission. Observers in Washington note, nevertheless, that the first subcommittee action of the Planning Committee is to draw Tariff Commission specialists into service for the subcommittees. Cooperation, rather than conflict, can, therefore, be expected.

Word from abroad reaching Washington indicates that the nationals of other countries are exhibiting quite as much timidity regarding negotiations with the United States as are American industrial groups. Sudden changes permitting new imports in return for like concessions for other goods abroad need not be expected. The practical consequence of the new tariff authority for the President may, therefore, be a restraining of the tendency abroad toward embargoes, quotas, and tariff raises on American goods rather than any actual new domestic adjustments downward. As the avowed desire of the Administration is admittedly first to secure increased foreign markets for American agricultural products, the benefits of tariff agreements are not expected to be either soon realized or numerous for the mineral industries.

Confidence

President Roosevelt appears to believe that the next most important Administration effort must be to establish business confidence on a firmer base, in order to secure the flow of funds into the capital-goods industries, housing, and industrial developments. Until excessive bank liquidity, now sterilizing much of the country's investment power, is remedied by such developments, no great opportunity exists for further progress in effecting reemployment. This program, of course, is directly of importance to the mines of the country, whose products go largely into activities that will be stimulated to the extent that the President succeeds in the present effort.

To the extent that the Administration is not successful in stimulating housing, industrial construction, and related capital-goods spending, a further effort towards commodity-price inflation will be necessary. Such a trend is, however, not expected to become dominant during the summer. But if the confidence campaign fails, the goods-price-inflation campaign will be resumed in the fall. Under these circumstances fair stability in the general commodity price index is forecast by economists in Washington for July and August. The only important exception which they cite is the possibility that a more than normal summer slump in buying may occur. In that event some price recessions in consumers' goods are, of course, expected.

Manganese "Fees" Paid

Cuban American Manganese Company paid fees for legal services to Colonel Joseph I. McMullen, an Army officer serving both on the Judge Advocate General's staff and in a technical capacity as adviser to the Assistant Secretary of War's office. This fact was admitted by the colonel before the House of Representatives Military Affairs Committee making a special investigation of Army purchasing policies.

Congressional and other Washington critics using this case as a springboard have been disporting themselves in a sea of criticism of many of the alleged relations between Government officials and industrial groups. Repercussions affecting several divisions of the mineral industries, especially manganese, may be expected.

Payment in Kind

Debt-payment day passed June 15 without remittance from any foreign debtors save one. This result was not unexpected, though until late in May it was hoped that Secretary Hull might secure some cash from Britain. The Secretary's last, rather despairing, gesture was his interpretation of the American stand sent through the British Ambassador June 12. The suggestion that payment in kind would be considered by the United States was the first official admission of this character.

Tin had been most discussed as a needed import which might well come from the British under these conditions. However, all of the 27 "strategic materials" which are either in limited supply or fully lacking from domestic sources were given some consideration

in Washington. Of the 27 commodities so classified, because they are vital to military preparedness, are twelve minerals, namely: antimony, chromium, iodine, manganese, mica, nickel, nitrates, platinum, quicksilver, tin, tungsten, and vanadium.

The "payment-in-kind" proposals of June 12 received somewhat of a setback about two weeks later, however, when Britain told the Secretary of State that Britain did not wish to undertake payment in kind.

Money

Speculation as to further adjustment of the gold value of a dollar and as to the rate of silver purchase continues in Washington. The President's absence on a Pacific cruise and a trip through the Northwest makes almost certain the belief that any new policies will await his return to Washington. Some, in fact, believe that the President wishes his absence to represent an assurance of stability in policy for at least six weeks or two months. These comments are presented with the corollary conclusion that business needs such stability to inspire new industrial financing.

The close of the fiscal year 1933-1934 with a much smaller deficit than forecast by the President in his message to Congress last January is not unexpected. Careful students of his message at the time it appeared did not believe possible the spending of money at the rate he then implied. These same informed critics say, however, that the lesser spending in the past six months will be more than offset by greater spending in the next semi-annual period. The gross Government debt will presumably, therefore, not be less than the forecast of last winter.

Under these circumstances ample opportunity will remain for the Government to accomplish further devaluation of the dollar and the intended silver adjustments bit by bit, as the Treasury plans carry forward through the summer and fall. Those changes, both inflationary in nature, are believed by close observers to have as great, or perhaps greater, interest for the Administration than the possibility of borrowing money at slightly lower interest rates.

Tennessee Copper Wins Competition

The Burra Burra copper-ore mine, of the Tennessee Copper Company, Ducktown, Tenn., which was operated 303,075 man-hours in 1933 without a lost-time accident, was the winner in the metal-mines group of the National Safety Competition of 1933, sponsored by the U. S. Bureau of Mines.

In the non-metallic mineral group, first place was given to the Retsof rock-salt mine, of the Retsof Mining Company, Retsof, N. Y.

NRA Announcements

G. W. Farny, Lead Code Administrator

General Hugh S. Johnson, National Recovery Administrator, announced on June 21 the appointment of George W. Farny, of Morris Plains, N. J., as administrator on the Code Authority of the lead industry, the nickel and nickel alloys industry, and the toll bridge industry.

Mr. Farny received his education in mining institutions in Russia, Germany, and Belgium. He has had a wide experience in connection with highways, including service as vice-president of the National Highways Association, chairman of the National County Roads Planning Commission, and as a member of the American Road Builders' Association.

J. B. Barry, Copper Industry Investigator

General Johnson announced on June 23 the appointment of John G. Barry, a mining engineer and geologist of El Paso, Tex., as a special investigator for the copper industry. Under the terms of the copper code, members of the industry are required to report to the Code Authority any action taken in connection with the required averaging of the 40-hour week over three-month periods and the Administrator is empowered to appoint a special investigator to contact both employers and employees and review conditions in the industry with regard to the limitation of hours and its observance.

H. O. King Granted Leave

General Johnson announced on June 19 that Division Administrator H. O. King will be granted a leave of absence from his duties with NRA in order that he may serve with the Copper Code Authority as impartial administrator for the copper industry until that work is organized and under way. This leave was granted Mr. King upon the unanimous request of the copper industry, a large number of independent copper and brass fabricators, and many disinterested persons who desire to see some restoration of work to copper miners.

Suspension of Assessment Work

The President on May 21 signed "Public Law No. 226," of the 73d Congress, being "An Act providing for the suspension of annual assessment work on mining claims held by location in the United States and Alaska," specifying that: "the same is hereby suspended as to all mining claims in the United States, including Alaska, during the year beginning at 12 o'clock meridian July 1, 1933, and ending at 12 o'clock meridian July 1, 1934: Provided, That the provisions of this Act shall not apply in the case of any claimant not entitled to exemption from the payment of a Federal income tax for the taxable year 1933: Provided Further, That every claimant of any such mining claim, in order to obtain the benefits of this Act, shall file, or cause to be filed, in the office where the location notice or certificate is recorded, on or before 12 o'clock meridian, July 1, 1934, a notice of his desire to hold said mining claim under this Act, which notice shall state that the claimant, or claimants, were entitled to exemption from the payment of a Federal income tax for the taxable year 1933: And Provided Further, That such suspension of assessment work shall not apply to more than six lode-mining claims held by the same person, nor to more than twelve lode-mining claims held by the same partnership, association, or corporation: And Provided Further, That such suspension of assessment work shall not apply to more than six placer-mining claims not to exceed one hundred and twenty acres (in all) held by the same person, nor to more than twelve placer-mining claims not to exceed two hundred and forty acres (in all) held by the same partnership, association, or corporation."

Complaint Against A.S.&R. Dismissed

The Federal Trade Commission made public on June 23 an order entered by it dismissing a complaint against the American Smelting & Refining Company, in which violation of Section 7 of the Clayton Act was charged. This is the section of the Clayton Act making it unlawful for a corporation to acquire the stock of another when the effect of such acquisition is to substantially lessen competition between the corporation making the acquisition and the corporation whose stock is acquired, or to restrain such commerce, or tend to create a monopoly.

Complaint was based upon acquisition by American Smelting & Refining Company, of New York, of the stock of Federated Metals Corporation, a New Jersey corporation, claimed to be a competitor of American Smelting & Refining. Said acquisition resulted from an agreement of Sept. 30, 1932, between the two companies, as a result of which a new company was formed bearing the name of Federated Metals Corporation, of Delaware.

Arizona Reservation Opened

Lost sight of in the press of other important legislation and in the passage of the Wheeler-Howard Indian Bill itself was an amendment to that measure which opens about 2,000,000 acres of ore-bearing lands in southwestern Arizona to prospecting and mining claims. The entire region is said to be rich in copper deposits and may result in important development work. A total of 177 claims have already been patented in the region.

The Pioneer mine of Pioneer Gold Mines, in the Bridge River district, British Columbia. Development operations on a larger scale, recently undertaken by the company, include the extension of No. 2 shaft from the 14th to the 20th level, and possibly to the 26th level, or to a depth of 3,125 ft. Milling capacity is being steadily increased, and is currently about 360 tons a day

Strikes at Canadian Mines Focus Attention on Labor Laws

District of Patricia, in Ontario, Rapidly Expanding Its Production—Aldermac Mine Only Property to Suffer Serious Damage From Forest Fires in the North—Gold Mineralization of the Cariboo Discussed

MINERS at Flin Flon, Manitoba, called a strike on June 11 that compelled the cessation of operations in the mine and smelter. On June 12 a group of about 300 miners at Noranda, Quebec, issued a manifesto and struck also, but operations there were not affected seriously; other men were engaged, and in a few days operations were normal again.

The conditions at these two large mines are somewhat different. Flin Flon is an isolated community in the far north of Manitoba, whose ore is only moderate in grade and whose continued operation throughout the period of low metal prices has been dependent upon reducing the cost. Among the means adopted were wage reductions, amounting to 18 per cent for single men and for married men 15 per cent less an allowance of 1 per cent for each child. By this means, continuous employment has been afforded to the 1,300 men on the payroll. The management has publicly attributed the strike to the activities of paid agitators of Communistic tendency. An immediate restoration of pay to the former levels and the recognition of the "Mine Workers Union of Canada" has been demanded by the strikers. The company has definitely refused the latter, but is ready to consider the possibility of restoring the former wage rates.

The income of Noranda Mines has not been reduced during recent years, due to the comparatively high gold content of the ore, and the scale of wages has not been cut. Strikers at Noranda demanded a 10 per cent increase in pay and recognition of the "Mine Workers Union of Canada." The strike has definitely failed. Few English-speaking employees were involved.

Agitation similar to that at Noranda has prevailed at Kirkland Lake and Porcupine, but no strikes have been called there.

These disturbances draw attention to two pertinent points. The first is a duty that has been pointed out to the Canadian mining fraternity most forcibly by S. G. Blaylock, vice-president and general manager of Consolidated Mining & Smelting, in his present capacity as president of the Canadian Institute of Mining & Metallurgy. Mr. Blaylock has urged upon mine managers the necessity for gaining the confidence of their men, as a means of forestalling the subversive influence of the agitators that now infest every mining camp. Mr. Blaylock speaks from the vantage point of a highly satisfactory relationship with his employees at Trail and Kimberly, B. C., where a profit-sharing scheme has been in successful operation for many years, and where mutual trust has been firmly established by fair dealing on both sides.

The second point involves "An Act Respecting the Extension of Collective Agreements," passed at the last session of the Quebec Provincial Legislature and now in force. Although this measure was enacted at the instance of those interested in establishing stable conditions in the manufacturing and construction industries, it applies equally to the mining industry. Its object is, in brief, to take the control of wage rates and hours of labor out of the hands of extremists on both sides and to put it in the hands of the large number (usually a majority) whose ideas are characteristically moderate. The Act provides for this very simply by stating that, when an accredited association of employers on the one hand and of employees on the other negotiate an agreement as to wages and hours of labor, this agreement shall be binding upon all other employers and employees in the same trade within the district affected, provided the terms of the agreement are not contrary to the public interest. The measure is, in effect, much like the codes established under the NRA, but different to an extent that makes it more suited to the Canadian temperament and conditions that prevail in Canada.

Authorities in the other provinces are watching closely the operation of this new Quebec Act, and in Manitoba a somewhat similar measure has already been passed. Indications are that the Quebec Act can be used to stabilize the conditions of labor in a satisfactory way in the Quebec mining fields, as is already being done in a number of other industries in the province.

Ontario

The District of Patricia, whose gold output was confined until recently to the Howey mine, is rapidly expanding its production. During the first quarter of the year the Howey treated 120,412 tons of ore, for a recovery of $430,000, averaging $3.57 per ton, at a cost of $1.85 per ton. Recovery in the second quarter will be about the same. For some months drifting on the 1,000-ft. level has been extended eastward along the gold-bearing zone, known to be 7,000 ft. in length on the company's property, into a part hitherto unexplored, except by occasional diamond-drill holes. This has indicated shoots of ore from two to four times the average grade of the mine.

At the McKenzie Red Lake property, a few miles north of the Howey, high-grade ore has been found to the third level and erection of a small mill is planned. The 50-ton mill of Casey Summit is expected to be operating in August, and the mine development to a depth of 300 ft. shows ore of good grade across a width of 30 in. The 50-ton mill of Central Patricia is in steady operation. Mining operations at Pickle-Crow so far have shown values substantially in excess of those indicated by diamond drilling. The 100-ton mill at this property is being erected rapidly

and will be put in operation as soon as power is available from the plant being constructed on the Albany River by the Ontario Hydro Electric Commission to serve this and the Central Patricia mines.

Porcupine Peninsular, formerly Nighthawk Peninsular, is the latest of the Porcupine properties to be re-examined in the light of the high price of gold. Ten years ago it was equipped with a 200-ton mill, with a view to mining a wide gold-bearing zone and gradually increasing the daily tonnage. The milling cost was too high to permit this, and even the selective mining of $7 ore resulted in a loss, so the attempt was abandoned. Anglo-Huronian is resampling and drilling the deposit, to determine the possibility of establishing a large-scale operation.

The Little Long Lac area, east of Lake Nipigon, will soon have a steady output of gold from the 200-ton mill of Little Long Lac Gold Mines, now under construction. The oreshoot, 800 ft. in length, has been developed to a depth of 500 ft. and is being followed deeper. The grade is high across a good stoping width. At the Dikdik property, to the west, development of the narrow vein that furnished high-grade ore from open cuts for shipment to the Flin Flon smelter is proceeding, and drifting is in progress on the 150-ft. level, at which level the high-grade ore continues.

At the Martin-Bird property along Larder Lake, 20 miles southeast of Kirkland Lake, the spectacular gold showings found on the surface a year ago have been duplicated in pits at shallow depths. A plant has been installed to carry development to a depth of 250 ft., with a view to determining the average grade of the zone throughout which these high grade occurrences and areas of more moderate value extend.

British Columbia

The degree of importance of the lode gold mineralization of the Cariboo, and the scale upon which future operations may be based, have been the subject of much recent discussion following the report of Ira B. Joralemon on Cariboo Gold Quartz Mines. The report was not made public at the recent meeting of the company, although it was referred to by the president, who said that the board of three directors was not entirely in agreement with Mr. Joralemon's figures and that no change in policy would be made until another independent report was forthcoming. An examination of the whole undertaking is being made at the present time by Norman J. Wynne, of the firm of McCarthy & Binns, of London, and in about six weeks this engineer's conclusions would probably be made public.

Newmont Mining Corporation is proceeding with plans for the erection of a 50-ton pilot mill which will be operated mainly for the purpose of obtaining representative results from the treatment of run-of-mine ore. Some new discoveries of ore of good grade are reported from the developments on the Island Mountain property of the company.

Proserpine Mountain Gold Mines, Ltd., is also carrying on an intensive campaign of development under the joint management of R. R. Wilson and Charles M. Campbell, who was formerly with the Granby company.

Treatment capacity of Pioneer Gold Mines will probably be increased in the near future. Officials of the company state that an ample reserve of ore exists to justify additional plant, and the only reason for delay is that the directors had not yet come to a decision as to the most suitable type of installation.

Satisfactory progress is reported at the Bralorne mine, where the capacity of the mill has been again stepped up to nearly equal that of its neighbor, the Pioneer.

Rumors are in circulation with regard to the developments at the Minto property. These are attributable to a large extent to the fact that the Seeley-Mudd interests, of San Francisco, recently relinquished the option which they held on a large block of the company's shares. Officials of the company state that the lower developments in the mine are entirely satisfactory, an oreshoot of good grade, with a width up to about 6 ft., having been developed over a distance of about 200 ft. Vancouver capital, according to reports, has undertaken the further financing of the operations. Plans for the early erection of a treatment plant are under consideration.

The main tunnel of B. C. Nickel Mines has been advanced to a distance of about 2,500 ft., or more than halfway toward its objective, which is the calculated downward extension of the nickel-bearing pyrrhotite that has been prospected at and near surface.

At the Dawson mine, in the Coquihalla Valley, under new management, attention is being devoted to developing the main "Boulder" vein, which heretofore has been somewhat neglected in favor of extracting high-grade ore from a limited oreshoot that occurs in the parallel "Dyke" vein. In recent work, which has been devoted to drifting on the Boulder vein at a higher elevation than the previous workings, high-grade ore is stated to have been encountered.

Another vein has been cut by a crosscut at the Vidette mine. This vein lies parallel to the main ore occurrence, upon which the work so far has been confined to a large extent. A crosscut driven to open it up at depth encountered high-grade ore, 9-in. wide. Drifting is being carried out on this vein. Gordon F. Dickson, managing director, reports favorable results from general development, the Tenford vein having been developed over a horizontal distance of about 500 ft. to a depth of 280 ft. Below this level the vein appears to pitch off more flatly and has not yet been encountered in exploratory workings from the main shaft at a further depth of about 120 ft.

South American Mines Corporation has made final payment on the purchase of the Nickel Plate mine, in the Hedley district, which was acquired from Hedley Gold Mines.

In the Nelson area, costs at the Reno, under the new management, have been reduced to $2.90 per ton for mining and $2.02 per ton for milling. Capacity of the mill has been increased to 100 tons, and preparation for the work of sinking a three-compartment shaft from the No. 5 level is well under way. The purpose is to sink 500 ft. and to cut stations at each 125-ft. level to give four horizons for immediate attack. Excellent results are also attending the operation of the Relief-Arlington, where about two years' ore supply has been made available at the present rate of production of 40 tons per day. Should, however, developments in progress justify, operations will probably be increased to at least 100 tons daily before the end of the year. Another property in this area which is giving a good account of itself is the Kootenay Belle, where the early construction of a mill is likely.

Quebec

The Aldermac mine suffered the only serious damage to active mine property from the numerous forest fires in northern Ontario and Quebec during the dry spell in May and June. On May 28 the power plant, hoist, and shops were destroyed. These have been replaced; the mine is in operation, and the mill, a mile distant on the railway, has resumed shipments of pyrite and copper concentrates. Drifting is under way to open the deposit of high-grade copper ore recently indicated by diamond drilling.

The "4" property, adjoining San Antonio on the east and largely under water, is to be explored from the shaft of San Antonio on the 600-ft. level, the distance to the "44" boundary being 1,200 ft. Drilling on "44" has given excellent results, and indications are that these will be found to continue westward into San Antonio ground.

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International Nickel Increases Interest in Ontario Refining

International Nickel acquired last month from American Metal for $1,595,306 an additional block of 13,324 shares of Ontario Refining stock. The transaction gives International Nickel a 90 per cent interest in Ontario Refining, and decreases American Metal's interest to 10 per cent.

PERSONAL ITEMS

Colonel E. J. Ristedt is attending Coast Artillery maneuvers.

Morris Jesup Elsing was in New York the latter part of June.

Fred Searls, Jr., has returned to Grass Valley, Calif., from New York.

R. Merz, assistant smelter superintendent at Roan Antelope, is on vacation.

S. R. Brown is making a professional visit to Yugoslavia for the Union Corporation.

Sydney H. Ball is spending six weeks in Ontario and British Columbia on professional business.

S. S. Saxton is developing the Timagami, Ontario, property of Manitoba & Eastern Mines.

Frank M. Leland is president of the Bear State Gold Mines, Ltd., with headquarters in San Francisco.

C. N. Schuette has moved his office from 306 Call Building, San Francisco, to room 533 in the same building.

E. Winslow-Spragge has been appointed vice-president and chief executive of Canadian Ingersoll-Rand Company.

Kenneth E. Hickok, formerly of Alma, Colo., is now mill superintendent for the Gold Standard Mines Corporation, Kingman, Ariz.

Smiley Jones, of Kingman, Ariz., has completed an ore sample display for the Arizona exhibit at the Century of Progress Exposition.

W. H. Newhouse has been appointed chairman of the committee on processes of ore deposition of the National Research Council.

Horace G. Young and Mrs. Young, with their son and daughter, have sailed from Montreal to England and the Continent for a two months' holiday.

Carl J. Nelson, mining engineer, sailed from San Francisco to join the staff of the Braden Copper Company at Rancagua, Chile.

Prof. Edward Sampson, geology department, Princeton University, has been appointed chairman of the department, succeeding **Prof. A. H. Phillips,** who remains as a special lecturer.

Harold A. Titcomb is on the way to Serbia to visit Trepca Mines, Ltd., and the other properties that Selection Trust companies are developing there.

John W. Prendergast, formerly in the Denver office of the United States Bureau of Roads, is now with the Climax Molybdenum Company, Leadville, Colo.

H. Y. Eagle has gone to Northern Rhodesia to start the new copper refinery of the Rhokana Corporation. He expects to be away about eight months.

Albert Burch, who is now living near Medford, Ore., is directing work of the Browne Gold & Silver Mining Company at Silver City, Nev.

J. C. Pickering, general manager of Patiño Mines & Enterprises Consolidated, Llallagua, Bolivia, is in New York. He expects to remain until September.

Parke A. Hodges has recently been employed by the American Metal Company, Ltd. He will travel as a field engineer for that company in the western part of the United States.

Carl Stoddard has been appointed consulting engineer and geologist of the Como Mines Company, succeeding **E. S. McCurdy,** of San Francisco. The company's property is in Lyon County, Nev.

George W. Farny, mining engineer, has been appointed NRA representative on the Code Authority of the lead industry and the nickel and nickel-alloy industry.

M. W. von Bernewitz has returned to the United States from Australia and is with the Battelle Memorial Institute, Columbus, Ohio, in charge of Battelle publications.

John G. Barry, mining engineer and geologist, has been appointed special investigator for the copper industry by General Hugh S. Johnson, National Recovery Administrator.

Jesse J. MacDonald is no longer connected with the Crown King Consolidated Mines Company, at Crown King, Ariz. He is now doing consulting work for the Sierra Vista Mining Company, at Laws, Calif., near Bishop.

M. King Hubbert, of Columbia University's department of geology, is spending the summer in the Kentucky-Illinois fluorspar district, where he is in charge of a geophysical party for the United States Geological Survey.

Gerald G. Dobbs is in charge of field operations for Minerals Limited, a recently incorporated company formed to carry on exploration work on several extensive gold-bearing areas recently acquired in the Province of Nova Scotia, Canada.

Robert B. Dickson has entered the employ of the American Metal Company, Ltd., as a field engineer, and will be engaged in traveling in the eastern part of the United States and eastern Canada.

Albion S. Howe, for many years general manager of Central Eureka Mining Company at Sutter Creek, Calif., has resigned his position to retire from professional work. He was succeeded by **James Spiers,** formerly superintendent.

C. T. Huang and **K. S. Chem,** head and assistant respectively of the department of mining of the Ministry of Industry of the Chinese Government at Nanking, have been visiting the Lake Superior iron country.

F. C. C. Lynch has been appointed head of the newly formed Bureau of Economic Geology at Ottawa, Canada, which has taken over from the Geological Survey certain of the administrative duties.

W. G. MacBride, professor of mining at McGill University, Montreal, has been retained by Alderson & MacKay in connection with their various properties and is now examining the Aldermac mine, in Rouyn.

R. N. Kappel, formerly with Benguet Consolidated and latterly with Antamok Goldfields Mining Company, in the Philippines, arrived in New York from Europe on June 14. He intends to look into gold mining possibilities in the United States.

Dr. W. L. Whitehead, of the department of geology at the Massachusetts Institute of Technology, is in the West on a tour of inspection of the properties of the Utah Apex Mining Company on the Mother Lode, in California, and at Bingham, Utah.

Arthur D. Storke left London late in May for Northern Rhodesia, where he will visit the properties of the companies of which he is managing director, Roan Antelope, Rhodesian Selection Trust, and Mufulira Copper Mines.

Henry P. Dutton, professor of factory management in the school of commerce, Northwestern University, has been appointed administration member of the basic code authority for the machinery and allied products industry, under which mining machinery manufacturers have supplemental codes.

C. D. Kaeding, who established at the Sherritt-Gordon in northern Manitoba a low cost for copper such as has been excelled only by much larger mines, has been appointed consulting engineer to Little Long Lac Gold Mines, in Ontario, and is now supervising the mine development and mill construction.

Kenneth M. Simpson has resigned as Divisional Administrator of the NRA and returned to private practice as a mining and metallurgical engineer. He is succeeded by **Charles E. Adams,** president of the Air Reduction Company and a director of the Vanadium Corporation of America.

R. W. Gallup is now leasing at Victor, Colo. He reports that leasing is active in the Victor district and that a number of small properties have been opened up. Operators are optimistic. The supply of local labor is ample, and miners from other camps are advised not to go to the district in search of employment.

A. M. Richmond, formerly assistant resident engineer for the British Columbia Provincial Government, and who has more recently carried on the duties of the Provincial Mineralogist following the resignation of John D. Galloway, has been appointed resident mining engineer for the No. 6 (Western) District and has assumed his duties in Vancouver.

C. H. Thurman, gold dredging engineer and president of the Snelling Gold Dredging Company, has moved his headquarters to the Folsom district, California, where he will supervise the

operations of the Gold Hill Company dredge on the Derby holdings, and the dredge of the Hill-Con Steamship Company now under construction on the Laird property near Loomis.

V. V. Clark, whose article on "Core Control in Alluvial Drilling" appears in this issue, has had many years of experience in placer and lode mining. Among those who have used his services are the Yuba Manufacturing Company, for which he has handled mining properties successfully, and the South American Gold & Platinum Company.

J. O. Elton and **A. B. Young,** manager and assistant manager respectively of International Smelting, attended a recent meeting at Elko, Nev., called to formulate plans for a highway between Elko and Boise City, Idaho, by way of Mountain City, where International, through its subsidiary Mountain City Copper, is developing the Rio Tinto copper mine. They inspected the mine in company with Superintendent **Al Loftquist.**

Frank G. Stevens is general manager of Central Porcupine Mines, Ltd., which has been formed to explore the ground between the Dome and McIntyre mines, in Porcupine. No rock outcrops have been noted in this area, but some old diamond drill records encourage the belief that the rock structures are favorable to the occurrence of gold. **D. G. H. Wright,** formerly geologist of Dome, is associated with the new venture as geologist.

F. Whalley Watson is now manager of the Dewey mine and mill, on the South Fork of Clearwater River, 6 miles east of Grangeville, Idaho. After many years of development and test work on this old mine, a cyanide mill has been installed and is now operating successfully on oxidized gold ores from three upper levels. **Clifton H.** and **F. W. Watson,** with the Kinkaid estate, are the owners and operators.

A. J. Keast, general manager of Beattie Gold Mines, has achieved at this Quebec property a record for speedy and economical development that will be hard to beat. In less than two years he has carved out of the wilderness a townsite, established a 1,000-ton mill, and developed a mine with over 3,000,000 tons of known ore and much more in prospect. The capital cost of this development was $1,100,000.

Albert H. Fay spent the month of June with the senior and junior mining students of Lafayette College, Easton, Pa., visiting mines at Sudbury, Kirkland Lake and Noranda, Canada. Word has been received that his son, Albert H. Fay, Jr., on graduating last month from the Columbia University School of Architecture, was awarded the Alpha Rho Chi medal for leadership and an $1,800 fellowship for graduate work to be carried on at Columbia.

W. S. Boyd, vice-president of the Nevada Consolidated Copper Corporation, San Francisco, has been elected to the chairmanship of the board of governors of the Western Division of the American Mining Congress. **W. Mont Ferry,** vice-president and managing director of the Silver King Coalition, Salt Lake City, Utah, has accepted the chairmanship of the program committee for the Western Division meeting to be held at the Palace Hotel, San Francisco, the week of Sept. 24.

Andrew T. Sweet, head of the metallurgy department of the Michigan College of Mining and Technology, and **John D. McCarthy,** of Detroit, have been granted a United States patent on a process of extracting manganese from ore. The method consists in treating the ore with a solvent for manganese and, by control of the concentration in the solvent, preventing other materials from going into solution. Application for patent was made in 1929. Rights have been assigned to the General Manganese Corporation.

John Arms has been elected secretary of the Board of Trustees of United Engineering Trustees, Inc., succeeding **Alfred D. Flinn,** resigned. He has been general manager of the corporation since December, 1933, and will combine the duties of both offices. He will be the chief administrative officer for the Board in caring for Engineering Societies Building, Engineering Societies Library, and the endowment funds which the Corporation holds for the four founder societies jointly. These properties are valued at approximately $4,000,000.

George Ingham is among those who have recently been added to the New Cornelia staff at Ajo, Ariz. He has been made mine superintendent. The others and their respective appointments are: **E. M. Reid,** shop foreman; **H. Cunningham,** chief engineer of power house; **W. B. Yarbough,** chief electrician; **A. T. Barr,** chief engineer; **E. G. Rawlins,** chief clerk; and **Dr. O. B. Patton,** chief surgeon. Most of these men are former New Cornelia officials but some have been transferred to Ajo from other Phelps Dodge branches. **W. L. DuMoulin** has returned to the organization as mechanical engineer.

McK. W. Kriegh, who was well known as the chief of the tax division of the American Mining Congress from 1921 to 1930, has resigned as an attorney for the Bureau of Internal Revenue and is now associated with the law offices of Colonel Edward Clifford, a former Assistant Secretary of the Treasury and an outstanding lawyer in Federal practice in Washington. Mr. Kriegh intends to devote special attention to problems connected with the national resources industries. He is an authority on questions of depletion and depreciation in the mining and oil industries under the various revenue laws and is the author of numerous articles on Federal, State, and local taxation.

Alden H. Emery, of the United States Bureau of Mines, who has recently returned from a trip to the land pebble district of Florida, reports that important advances in increasing recoveries and reduction of losses have been made by phosphate companies operating there. New phosphate washeries are being built incorporating the latest recovery principles, including flotation, oiling, and tabling and scrubbers and screens of high efficiency, Mr. Emory reports. The developments were attributed to research over a period of years by the Bureau of Mines, equipment manufacturers, and the companies themselves. The present tendency in the plants he visited, Mr. Emery said, is to re-treat débris from screening plants. All companies not re-treating at present are saving tailings in expectation of later re-treatment. Mr. Emery also visited the plant of the American Diatomite Company, at Clermont, Fla., which he said is now in production with a new method of recovery developed recently by its engineers. The raw material used at the plant is diatomaceous peat dredged from shallow lakes.

OBITUARY

Willis Z. Kinney, well-known Colorado mining man, died in Denver on June 24, at the age of 74.

Henry Blumenburg, Jr., discoverer of the great borax mine at Kramer, Calif., died recently at Los Angeles, at the age of 60.

Henry Burton Blades, well known to the mining fraternity of Utah, died recently at Salt Lake City. He was 64 years old.

Arthur Thacher, prominent mining engineer, died on July 2 at St. Louis, Mo. During the latter part of his life he was associated with the New Jersey Zinc Company. He was 78 years old.

Professor Jacob Johannes Sederholm, 71, noted geologist, died on June 27 at Helsingfors, Finland. He was well known in the United States, where he co-operated with scientists in the study of Pre-Cambrian formations.

J. Tom Lewis, safety engineer for the Arizona Industrial Commission, died in Phoenix on May 23 as a result of injuries received in an automobile accident. He was a pioneer of Gila County and former member of the State Legislature. Mr. Lewis was 63 years old.

Samuel S. Arentz, former Congressman from Nevada and known throughout mining districts of the West, died at Reno on June 17, at the age of 54. In 1914, Mr. Arentz was consulting engineer for the United States Bureau of Mines and during the War he was a captain in the United States Army Engineers Corps.

Ruel Chaffee Warriner, consulting mining engineer, died at Johannesburg, South Africa, on July 1. Mr. Warriner was a graduate of Lehigh University School of Mines. For many years he had been connected with the mining interests of South Africa, aiding in the organization of Crown Mines, one of the great gold producers of the world. He was a member of the South African Association of Engineers, the Chemical and Metallurgical Society of South Africa, and Delta Upsilon fraternity.

E. Frank Knotts, former president of the Erupcion Mining Company, in Chihuahua, and a promoter of various mining enterprises, died in El Paso June 14, aged 70. He was well known on both sides of the border. One of his experiences (which on one occasion he described to a member of the *E.&M.J.* staff) was that of being captured by Pancho Villa, who held him until ransom was paid, meanwhile threatening him with death. Villa was very much in earnest, according to Mr. Knotts.

NEW BOOKS

A Series on Mining Begins

MINERAL DEPOSITS. *Henry Louis. Ernest Benn, Ltd., 154 Fleet St., London, E. C. 4, England. Pp. 384. Price, 30s. net.*

To appreciate the rather unorthodox treatment of the subject of mineral deposits as carried out in this volume one must know that the author has written it as an "introduction to a series of volumes dealing with the various operations of mining" and that "it is written solely from the point of view of the miner." By "miner," evidently, is meant the student or graduate of mining engineering, inasmuch as the book contains entirely too much technical discussion for the uneducated miner.

The plan followed is: (1) a discussion of the classification of mineral deposits and of fissures and faults; (2) the description of the various classes of mineral deposits following the author's new scheme of classification, illustrated by typical examples; and (3) a brief description of the leading mineral deposits of the world under four divisional headings as follows: I, Fuels; II, Ores or Metallic Minerals; III, Salts; and IV, Gems. Division V, Rock Masses, is excluded purposely as not falling within the scope of the book.

In keeping with the objective of the volume, the classification adopted is mainly morphologic but also partly genetic. The two major divisions are designated "symphytic" and "epactic" deposits, "signifying respectively contemporaneous with the geological formation, and subsequent to the formation, within which the deposit occurs." These are unfamiliar terms to most American geologists and mining engineers. The term "symphytic" is practically synonymous with "syngenetic," but "epactic" is not used in exactly the same sense as "epigenetic," for it includes mineral deposits in igneous rocks which are contemporaneous with the immediate enclosing rock but not with the "surrounding strata of the Earth's crust."

The classification, used as a basis for the description of mineral deposits, is as follows:

"Class I. Symphytic Deposits:
- Group *a*. Clastic deposits.
- Group *b*. Deposits formed by chemical agencies; for example, precipitates, metasomatic deposits, residual deposits.
- Group *c*. Deposits formed by organic agencies.
- Group *d*. Disseminations through beds.

"Class II. Epactic Deposits:
Sub-class A. Veins:
- Group *a*. Fissure veins.
- Group *b*. Bedded veins.

Sub-class B. Masses:
- Group *c*. Stockworks.
- Group *d*. Disseminations in igneous rocks.
- Group *e*. Magmatic deposits.
- Group *f*. Masses connected with soluble rocks."

All the author claims for this classification is "that it corresponds reasonably well with observed facts, that it answers the practical needs of the miner, that it enables a useful view to be obtained of a very involved subject, and that it is not illogical." In the opinion of the reviewer it would have been better to have used either a purely morphologic or a purely genetic classification rather than a combination of the two. The fundamental difficulty of such a classification is well expressed by the author when he states that many of the deposits described are "symphytic" in form and "epactic" in origin. This difficulty is noted throughout the book.

Quite naturally, the author devotes most of his space to the description of the mineral deposits of the British Empire. A more adequate treatment of the many important deposits in South America and Mexico seems desirable.

The literary style of the book is to be commended. Involved technical discussions and descriptions are clearly presented. Only 41 illustrations are listed in the 384 pages, and the index is too brief.

For geologists and engineers of the Western Hemisphere the chief value of the book appears to be as a reference volume in which one may find brief abstracts of the geology of many mineral deposits throughout the world, especially those located in the British Isles and elsewhere in the Empire.

C. A. BONINE.

Monetary History

"SOUND" AND "UNSOUND" MONEY. *By Tyman O. Abbott. The Telegraph Press, Harrisburg, Pa. Pp. 223. Price $1.50.*

This volume is a documentary study of the monetary history of the United States by a member of the bar of the states of New York and California, and of the Supreme Court of the United States. With legal precision the author clarifies the meaning of such monetary terms as free and unlimited coinage, fiat money, greenbacks, bimetallism, double standard, ratio, parity, gold standard, and many others, and paves the way for a clear understanding of our monetary policy.

The monetary history of the United States is divided into two parts: First, from 1792 to 1873, during which period bimetallism prevailed; and second, from 1873 to 1933, when gold was the sole standard. In contrasting 81 years of bimetallism with 60 years of continuous legislative experiment the author reviews business conditions and financial panics of the two eras. He rests his case for bimetallism on "the voice of experience vs. the voice of theory," and quotes voluminously from the Constitution, federal legislation, and the messages of the Presidents. In this manner he asks the reader to sit in judgment and decide for himself what money is "sound" and what "unsound."

Publications Received

Steinbearbeitung. By Karl Röder, Werner Gruner, Walter Kerner, Gotthold Pahlitzsch. VDI Verlag, Berlin. Pp. 41. A study of the methods used in cutting, drilling, planing, and polishing building stone and glass, with a scientific examination of the stresses and forces occurring during these operations.

Bulletin No. 103 of the Geological Commission of Finland. Contents include: "On the Differential Anatexis of Rocks," by Pentti Eskola; and "On the Chrome Minerals of Outokumpu," by Pentti Eskola.

International Raw Commodity Prices and the Devaluation of the Dollar. Business Research Studies No. 5. Melvin T. Copeland, Graduate School of Business Administration, Harvard University, Boston. Price $2.

Bibliography of the Geology and Mineral Resources of California, to Dec. 31, 1930. By Solon Shedd. Bulletin 104. Issued by the California State Division of Mines, Ferry Building, San Francisco.

Mining Industry of Idaho, 1933, Thirty-fifth Annual Report. By W. H. Simons, Inspector of Mines, Boise, Idaho. Pp. 256.

Bibliography of North American Geology, 1931 and 1932. U. S. Geological Survey Bulletin 858. Pp. 300.

List of Publications, U. S. Bureau of Mines, 1910, 1932, with subject index. Superintendent of Documents, Washington, D. C. Pp. 231.

Rechnerische Betrachtungen über Verbrennungsvorgänge und Abgasverluste bei Feuerungen, in besondere bei Kalk-und Zementöfen Von Dipl. Ing, Dr. Zoltán Kertèsz, Turda (Siebenbürgen), Mit 25 Abbidungen. Halle (Saale), Verlag von Wilhelm Knapp. Rm. 4.80. gebd. Rm. 6.

Year Book of the American Bureau of Metal Statistics. Fourteenth Annual Issue, 1933. Published by the American Bureau of Metal Statistics, 33 Rector St., New York City. Pp. 112. Price $2.

EQUIPMENT NEWS

Water Sterilizing Device Utilizes Silver

Ionized Metal Quickly Kills Bacteria

Based on the new electro-catadyn process of water sterilization by the use of ionized silver, Katadyn, Inc., New York City, has developed a simple, compact sterilizer specially suited to the use of geologists, prospectors, and other members of the mining fraternity who wish to be assured of the purity of their drinking water while operating in the field. As shown in the accompanying illustrations, the sterilizer consists of a standard dry cell or cells, contained in a metal cylinder to which two silver electrodes can be attached. All the parts fit conveniently into a bakelite case that can be conveniently carried in the coat pocket.

To sterilize drinking water, the silver electrodes of the assembled apparatus are inserted in a container of water, the time of contact varying from 15 to 20 seconds for ¾ liter (1½ pint) to 60 to 80 seconds for 1 liter (1 quart). If the water is turbid or contains suspended matter it should first be filtered. It is claimed that one hour after treatment the water is free from disease-producing germs and can be drunk without danger.

The pocket sterilizer for individual use is merely a handy form of larger apparatus designed for the commercial treatment of large quantities of industrial or domestic water supplies. The method depends on the influence of very small quantities of ionic silver dissolved in water. When thus treated, water possesses bactericidal properties that persist as long as the silver remains in solution. The ionic silver does not kill bacteria immediately but, depending on the number of germs and the properties of the water, requires from 30 minutes to several hours for sterilization. The mechanism of the process is obscure, but it is regarded by authorities as effective and it is declared to be harmless to the human organism.

Sterilizing a glass of water with the Katadyn

Below—The Katadyn disassembled

Dredge for Small Placers

To make possible economical exploitation of small or shallow areas of gold-bearing gravel, Yuba Manufacturing Company, of San Francisco, Calif., has developed a small gold-placer dredge known as the Yuba Jr. Important features embodied in its construction are a sectionalized hull, superstructure, and auxiliaries for easy and quick assembly and transportation by truck.

The hull is constructed of steel pontoons, a recent development by Yuba, and upper and lower tumblers, main drive, winch, pumps, screen, screen drive, and stacker are of standard Yuba design. The 1½-cu.ft. manganese steel buckets are of the bowl shape or clay type, suitable for all kinds of placer formation. Total weight of the machine is about 110 tons, and capacity exceeds 800 cu.yd. per day. Maximum digging depth is 16 ft. below water level, and motive power is furnished by self-contained diesel engines. The new unit constitutes a marked advance in dredge construction.

A New Placer Machine

What is known as the Hartman-Gold King placer machine has recently been introduced by the Mining Equipment Sales Company, 206 North Serrano St., Los Angeles. The No. 1 size has a bank run capacity of about 5 cu.yd. per hour. It is mounted on wood skids 7 ft. 9 in. long, and can be easily transported, weighing only 1,000 lb. It has a revolving trommel screen with a 30x14-in. scrubbing chamber equipped with lifting vanes that pick up and drop the gravel. This revolves at 50 r.p.m. The discharge passes through a ⅜-in. perforated conical screen, the oversize going to a chute having two nugget traps, and the undersize directly to the undercurrent board. As the gold is caught in the riffles, it is moved to a V-trough at one side and is then caught in a pocket, where the final clean-up is made. A vibrating riffle above the board is used to insure good agitation.

Another Mercury Vapor Lamp

Quicksilver is responsible for a new light source that is expected to exert considerable influence on artificial lighting practice of the future, according to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The new source was developed in the laboratories of the company and is known as the high-pressure mercury lamp. The lamp has no filament, the light being produced by a mercury arc stream of great brilliancy. The development of this lamp is thought to mark a definite forward step in the use of metallic vapor light sources.

Cuts Grease From Machinery

For removing grease, sludge, and dirt in general from machinery, walls, and floors the Homestead Valve Manufacturing Company, Corapolis, Pa., has improved its so-called Hypressure Jenny in several respects. This device supplies water at 200 deg. F. with a nozzle velocity up to 175 lb. per square inch. On striking the air the hot water flashes into a vapor spray, which is said to be a constant combination of steam and water. This pelts the surface to be cleaned with fine globules of water. By introducing proper detergents into the feed water, thorough cleaning is accomplished. Improvements made include simplification of the mechanism, use of rotary pumps, devising of a saturation selector whereby the mixture of the spray can be changed, and increased accessibility of parts.

Automatic Manometer-Regulator

A new type of manometer fitted with automatic electric control features is now being manufactured by the Meriam Company, Cleveland, Ohio. It is stated to be sturdy and simple, and to remain permanently accurate in severest service. It is adaptable to a wide variety of direct and differential control uses for pumps, liquid levels in tanks and sprinkler systems, and for maintaining gas pressure and flow between close limits; or for starting and stopping the flow in two pipes alternately for special purposes.

Tellurium Lead Resistant to Corrosion

Lead containing less than 0.1 per cent of tellurium has been found superior to ordinary lead in its greater resistance to corrosion by acids, its greater tensile strength, its increased resistance to fatigue failure resulting from vibration or from repeated stresses, and its generally better working qualities. It is a British discovery. It has recently been introduced into the United States by the National Lead Company. The presence of the minute quantity of tellurium causes a marked change in physical structure. Photomicrographs show the grain formation of tellurium lead to be extremely fine and uniform, in contrast to the roughness and coarse crystalline formations characterizing ordinary lead.

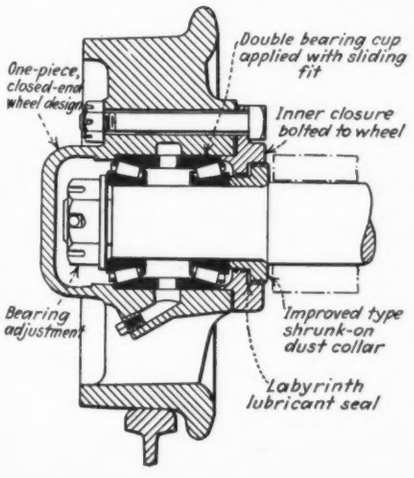
Potentiometer Pyrometer

A new potentiometer pyrometer, operated by an electronic relay and named "Galvatron" after the galvanometer-electronic relay circuit which it employs to operate slide wire resistances and recording pens, has been developed by the Bailey Meter Company, Cleveland, Ohio. One of these instruments may include as many as four potentiometer circuits, the contact-making galvanometer being automatically switched from one circuit to the next by relays actuated from contacts made by a synchronous motor-driven time device. One powerful synchronous motor drives these timing contacts for the relay as well as the galvanometer contacting mechanism, the recording chart, and the automatic standardizing relay contacts. A feature of the new instrument is its continuous record or records, up to four in number, made on a circular recording chart.

Mine-Car Bearing Mounting

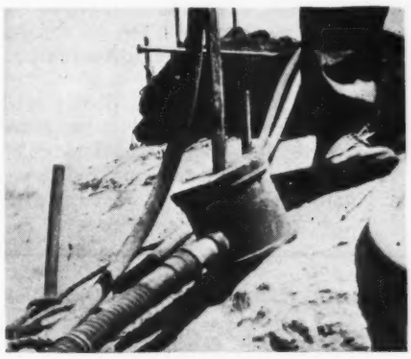
For mine-car service the Timken Roller Bearing Company, Canton, Ohio, has developed a new type of bearing mounting shown in the illustration. In it a double cup bearing is used instead of two single cups. The designer has retained the shrunk-on dust collar, which features the company's mountings, but has modified it so as to provide a labyrinth seal in conjunction with the inner closure. With respect to the features pointed out in the illustration, the use of the double bearing cup applied with a sliding fit is said to eliminate pressing-in and simplifies assembly and disassembly. The inner closure bolted to the wheel holds the double bearing cup in place in the hub. By means of the one-piece closed-end wheel design, the need of a separate end cap is eliminated. Furthermore, the bearing adjustment and lubricant are not disturbed when the wheel is removed.

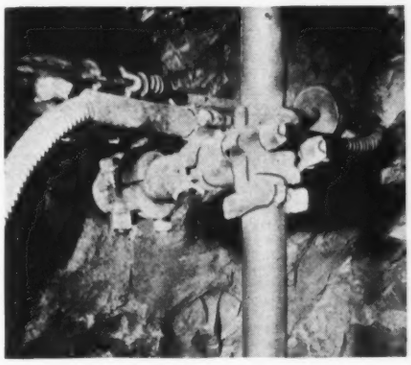
Sectional drawing of new mine-car bearing mounting


Double bearing cup applied with sliding fit
One-piece, closed-end wheel design
Inner closure bolted to wheel
Bearing adjustment
Improved type shrunk-on dust collar
Labyrinth lubricant seal

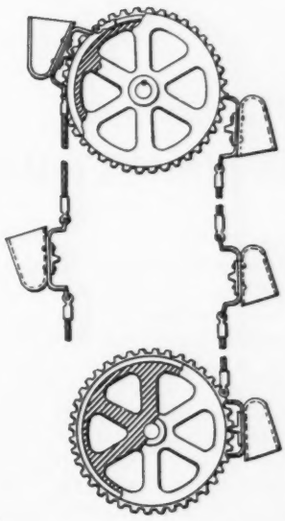
Dust Collecting in Mines

A complete vacuum equipment for the control of rock drill dust in mines and quarries is illustrated on this page. It is known as the Spencer Drill-Vac and is made by the Spencer Turbine Co., Hartford, Conn. It consists of a stationary or portable vacuum producer and separator, portable primary separators, together with a hose and vacuum hoods that withdraw the dust from the top of the drill hole as fast as it accumulates. The hood is a metal cap, which is placed against the rock face and through which the drill steel can be easily inserted, as shown. This is connected through a primary and secondary separator by means of flexible hose connections to the vacuum producer. Hoods have been adapted for vertical, horizontal, and stope drilling and are so arranged and mounted as to become immediately effective when collaring the hole. Thus the drill steel can be changed without inconvenience or delay. No attempt is made to keep a tight seal between the hood and the rock face, inasmuch as a sufficient volume of air is maintained through the hood.





Above—Suction device for collecting dust from rock-drill holes, in use in a quarry. Below—The same device adapted to underground service



Rope-type Elevator Improved

A modification in the construction of rope-type elevators and conveyors, whereby the conventional flat belt or chain elevator is replaced with rope-links riding in a grooved sheave pulley having geared rims, has been patented by R. A. Browning, of Rosiclare, Ill. Suitable buckets or carriers may be adopted according to the type of material handled. The advantages claimed by the patentee are light weight, high tensile strength, flexibility, reduced power requirements, and ability to repair quickly. In case a link becomes broken or worn, it is necessary only to snap on a new one. According to the inventor, moreover, with an open link there is practically no friction as in the case of roller cogs, slipping belts, and the like. The Adam Fisher Company, of St. Louis, Mo., is handling the manufacturing rights.

Bulletins

Yuba Junior Gold Dredge. Yuba Manufacturing Co., San Francisco. Folder. Pp. 4.

Denver Super-agitator, Wallace Type. Denver Equipment Co., Denver, Colo. Bulletin 3423. Pp. 4.

Denver Sub-A Flotation Cell. Denver Equipment Co., Denver, Colo. Folder. Pp. 8.

Utility Air Hoists. Ingersoll-Rand Co., New York. Bulletin. Pp. 32.

Stainless Steels. Edgar Allen & Co., Ltd., Sheffield 9, England. Folder. Pp. 8.

Refractories. Johns-Manville, New York. Leaflet on J-M Superex blocks for temperatures up to 1900 deg. F. Pp. 4.

Centrifugal Blowers and Exhausters. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 120-B10. Pp. 4.

Murray-Cornish Rubber-faced Rollers and Sheaves. D. J. Murray Manufacturing Co., Wausau, Wis. Folder. Pp. 4.

Calyx Core Drills, Class W Ingersoll-Rand Co., New York. Folder. Pp. 4.

Portable Compressor. Ingersoll-Rand Co., New York. Folder. Pp. 6.

Internal-Furnace Boiler. Babcock & Wilcox Co., New York. Bulletin G-17. Pp. 20.

Cyanidation. Merrill Company, San Francisco. Bulletin on "Merrill-Crowe Simultaneous Clarification Precipitation Process."

Automatic Furnace-Pressure Control. Leeds & Northrup Company, Philadelphia, Pa. Bulletin 842 (for metallurgical and other industrial furnaces).

Power-Factor Improvement. General Electric Co., Schenectady, N. Y. Bulletin GES-1012. Pp. 14.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

THE MOVEMENT of prices for non-ferrous metals during June was irregular. Copper, under Code control, was raised in price to the basis of 9c. per pound, Connecticut Valley. Silver scored a net gain of 1⅝c. per ounce, following announcement from Washington that the Treasury had embarked on the purchase of silver, and Secretary Morgenthau pledged himself to carry out "enthusiastically" the spirit of the Silver Purchase Act. The metals that are more or less free so far as trading is concerned sold at lower levels than a month ago. Purchases of copper were larger than in May. Buying of lead, zinc, and tin diminished.

During the first week in June the news got out that copper was about to be advanced so as to bring the price a little more in line with the average cost of production. Also, it was learned, fabricators were anxious for a higher quotation. In the period from June 6 to June 11 more than 43,000 tons of copper changed hands, mostly for September delivery, and the market soon became established on the 9c. basis. World stocks of refined copper at the end of May were estimated at 538,373 short tons, against 567,600 tons a month previous. The foreign price declined on evidence of a recession in buying abroad and a rising rate of production outside of the United States.

The ban on sales of non-Blue Eagle copper in the domestic market has been extended to Sept. 30. Companies consuming about 95 per cent of the domestic output of copper have signed agreements with the Copper Code Authority to purchase their requirements under the Code and have been authorized to certify their products as containing only Blue Eagle copper. The monthly quota for sales of secondary copper has been increased to 10,250 tons.

Refined lead stocks increased 10,450 tons during May, which accounts for the unexpected weakness in that metal late in the month. Zinc steadied shortly before the close on indications that concentrate production would be restricted in the Tri-State district.

The *E.&M.J.* weighted index of non-ferrous metal prices for June was 69.32, against 68.87 in May, and 69.42 in April. Higher monthly averages for copper and silver brought about the advance in the index for June.

United States Market

June	Electrolytic Copper: Domestic (a)	Electrolytic Copper: Export (b)	Straits Tin: New York (c)	Lead: New York	Lead: St. Louis	Zinc: St. Louis
1	8.500	8.275	7.850	52.350	4.00	3.85	4.30
2	8.500	8.275	7.850	52.250	4.00	3.85	4.30
4	8.500	8.275	7.750	51.600	4.00	3.85	4.25
5	8.500	8.275	7.725	51.400	4.00	3.85	4.25
6	8.500	8.275	7.725	51.800	4.00	3.85	4.25
7	8.500	8.275	7.825	52.500	4.00	3.85	4.25
8	8.500	8.275	7.850	52.000	4.00	3.85	4.25
9	8.500	8.275	7.825	52.000	4.00	3.85	4.25
11	8.500	8.275	7.875	51.600	4.00	3.85	4.25
12	8.960	8.735	7.850	51.250	4.00	3.85	4.25
13	8.837	8.612	7.825	51.100	4.00	3.85	4.20
14	9.000	8.775	7.750	50.500	4.00	3.85	4.20@4.25
15	9.000	8.775	7.725	50.500	4.00	3.85	4.20
16	9.000	8.775	7.725	50.600	4.00	3.85	4.20@4.25
18	9.000	8.775	7.725	50.250	4.00	3.85	4.20
19	9.000	8.775	7.700	51.000	4.00	3.85	4.20
20	9.000	8.775	7.700	51.050	4.00	3.85	4.20
21	9.000	8.775	7.650	50.800	4.00	3.85	4.20
22	9.000	8.775	7.550	51.000	4.00	3.85	4.20
23	9.000	8.775	7.550	51.000	4.00	3.85	4.20
25	9.000	8.775	7.550	51.250	4.00	3.85	4.20
26	9.000	8.775	7.550	50.775	4.00	3.85	4.20
27	9.000	8.775	7.550	51.000	4.00	3.85	4.25
28	9.000	8.775	7.575	51.300	3.85	3.70	4.25@4.35
29	9.000	8.775	7.550	51.125	3.75	3.60	4.30@4.35
30	9.000	8.775	7.525	51.050	3.75	3.60	4.30@4.35
Av. for month		8.594	7.705	51.271	3.975	3.825	4.240
Averages for Week							
6		8.275	7.792	52.008	4.00	3.85	4.275
13		8.408	7.842	51.742	4.00	3.85	4.242
20		8.775	7.721	50.650	4.00	3.85	4.208
27		8.775	7.567	50.971	4.00	3.85	4.208
Calendar Week Averages							
2		8.275	7.863	52.705	4.000	3.850	4.305
9		8.275	7.783	51.883	4.000	3.850	4.250
16		8.658	7.792	50.925	4.000	3.850	4.225
23		8.775	7.646	50.850	4.000	3.850	4.200
30		8.775	7.550	51.083	3.892	3.742	4.267

Silver, Gold, and Sterling Exchange New York and London

June	Sterling Exchange: "Checks"	Sterling Exchange: "90-day" Demand"	Silver (d): New York	Silver (d): London	Gold: London	Gold (e): United States
1	5.06500	5.06750	44.6250	19.5000	137s 1½d	$35.00
2	5.06375	5.06625	44.5000	19.4375	137s 2 d	35.00
4	5.04375	5.04750	44.6250	19.5000	137s 2 d	35.00
5	5.03750	5.04000	44.7500	19.6875	138s	35.00
6	5.05250	5.05500	45.0000	19.8125	137s 10½d	35.00
7	5.07375	5.07750	45.2500	19.7500	137s 1½d	35.00
8	5.06250	5.06500	45.1250	19.7500	137s 4½d	35.00
9	5.06625	5.07000	45.1250	19.7500	137s 8½d	35.00
11	5.05500	5.05875	45.0000	19.6875	137s 9½d	35.00
12	5.05250	5.05625	45.0000	19.6250	137s 7½d	35.00
13	5.03750	5.04125	45.2500	19.9375	138s 1½d	35.00
14	5.04500	5.04750	45.2500	19.8750	137s 8½d	35.00
15	5.04625	5.04875	45.0000	19.8125	137s 8½d	35.00
16	5.05000	5.05250	44.8750	19.6875	137s 9 d	35.00
18	5.04500	5.04750	44.8750	19.6875	137s 9 d	35.00
19	5.04750	5.05000	45.1250	19.8125	137s 9½d	35.00
20	5.03750	5.04125	45.0000	19.8750	137s 10½d	35.00
21	5.03625	5.03750	45.1250	19.9375	138s ½d	35.00
22	5.03375	5.03625	45.1250	20.0625	138s 1 d	35.00
23	5.03500	5.03875	45.2500	20.3125	138s 1 d	35.00
25	5.03000	5.03250	45.2500	20.3750	138s 1 d	35.00
26	5.02625	5.02750	45.2500	20.3125	138s 2½d	35.00
27	5.04000	5.04125	45.6250	20.4375	138s 1½d	35.00
28	5.05125	5.05250	46.0000	20.7500	137s 8 d	35.00
29	5.05250	5.05375	46.2500	21.1250	137s 5 d	35.00
30	5.04125	5.04250	46.2500	21.0000	137s 10½d	35.00
Av for month	5.04721	.....	45.173	19.981	.....	35.00
Averages for Week						
6	5.05479	.....	44.729	.....	.....	.....
13	5.05792	.....	45.125	.....	.....	.....
20	5.04521	.....	45.021	.....	.....	.....
27	5.03354	.....	45.271	.....	.....	.....
..	.....	.....	.....	.....	.....	.....

Calendar week averages: New York Silver June 2, 44.775; June 9, 44.979; June 16, 45.063; June 23, 45.083; June 30, 45,771.

(*a*) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(*b*) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(*c*) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per pound above our f.o.b. refinery quotation

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(*d*) Silver other than newly mined domestic Under Executive order issued Dec. 31, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(*e*) U. S. Treasury's gold price.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
June	Spot	3 Mo.	(Bid)	Spot	3 Mo.	Spot	3 Mo.	Spot	3 Mo.
1	32.6875	33.0000	36.0000	231.1250	228.5000	11.1250	11.3750	14.8125	15.1250
4	32.2500	32.5625	35.6250	229.0000	226.2500	10.8750	11.1875	14.6875	15.0000
5	32.3125	32.5625	35.6250	228.0000	225.7500	11.0000	11.2500	14.5625	14.9375
6	32.4375	32.7500	35.6250	228.2500	226.1250	11.1250	11.3750	14.6875	15.0000
7	32.6875	33.0000	35.7500	231.7500	229.7500	11.1875	11.4375	14.8750	15.1250
8	32.5000	32.8125	35.5000	230.2500	228.2500	11.1250	11.3750	14.8750	15.0625
11	32.9375	33.2500	36.0000	228.5000	227.2500	10.9375	11.3125	14.8125	15.0000
12	32.6875	33.0000	36.0000	227.0000	226.2500	11.0625	11.3750	14.7500	14.9375
13	32.8125	33.1250	36.0000	226.2500	225.5000	10.9375	11.2500	14.5000	14.6875
14	32.5000	32.8125	35.7500	224.2500	224.2500	11.0000	11.2500	14.3125	14.5000
15	32.0625	32.3750	35.2500	222.7500	222.7500	11.0000	11.2500	14.0000	14.2500
18	32.1250	32.4375	35.2500	222.2500	222.5000	11.0625	11.2500	14.0000	14.2500
19	32.2500	32.5625	35.2500	225.5000	225.7500	11.0625	11.2500	14.0000	14.2500
20	32.0625	32.3750	35.2500	226.1250	226.3750	11.0625	11.1875	14.0000	14.1875
21	32.0000	32.3125	35.2500	225.7500	226.0000	11.0000	11.1875	13.9375	14.1250
22	31.6250	32.0000	34.7500	226.2500	226.3750	11.0000	11.1250	13.6875	13.8750
25	31.6250	32.0000	34.7500	227.5000	227.5000	11.0000	11.1250	13.5625	13.7500
26	31.5000	31.9375	34.7500	226.6250	226 3750	11.1250	11.2500	13.6250	13.8125
27	31.4375	31.8750	34.7500	225.3750	225.0000	11.1250	11.2500	13.6250	13.8125
28	31.3750	31.8125	34.7500	226.2500	225.7500	11.1875	11.1250	13.7500	13.9375
29	31.2500	31.6875	34.2500	225.6250	225.5000	11.1250	11.1250	14.0000	14.1875
Av. for month	32.149	.....	35.339	226.875	.....	11.054	11.253	14.241	14.467

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(July 2, 1934)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	23.30c.
Antimony, domestic and Chinese (duty paid), lb.	7.75c.
Bismuth, ton lots, lb.	$1.20
Cadmium, lb.	55.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$23.00
Platinum, troy oz.	$36.00
Quicksilver, flask of 76 lb.	$74.50@$75.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$1.80
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent. c.i.f., long ton	$17.00@$18.00
Iron Ore, Lake Superior, long ton:	
Old Range, bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$35.00@$37.50
Manganese Ore, long ton unit:	
52@55 per cent.	24c.
49@51 per cent.	23c.
44@47 per cent.	22c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese, duty paid	$17.50@$17.75
Domestic Scheelite	$17.50@.....
Vanadium Ore, per lb. of contained V_2O_5	26c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$28.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	4c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, 100 lb.	$1.31½
Sodium Sulphate, bulk ton	$13.00@$15.00

Alloys

Beryllium-Copper, 12.5 per cent Be, 51 to 200 lb., lb.	$3.81
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$450@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32@ $37
Shorts	$11@ $15
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$5.00@ $6.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois, 85-5 per cent, ton	$17.00@.....
Fuller's earth, f.o.b. Georgia or Florida, ton	$10.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$9.00@$12.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley, furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets and Sheet bars, gross ton	$29.00
Structural shapes, 100 lb.	$1.85
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1933	1934	1933	1934	1933	1934
January	25.400	44.188	16.883	19.382	336.060	504.644
February	26.074	45.233	16.885	20.073	342.114	503.085
March	27.928	45.875	17.588	20.278	343.138	509.259
April	30.730	45.180	18.440	19.740	357.565	515.210
May	34.072	44.226	19.046	19.276	393.106	510.510
June	35.663	45.173	19.078	19.981	413.216	504.721
July	37.630		18.341		464.760	
August	36.074		17.877		449.944	
September	38.440		18.272		466.240	
October	38.190		18.221		466.380	
November	42.974		18.428		514.573	
December	43.550		18.674		511.260	
Year	34.727		18.144		421.530	

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery — Electrolytic — Domestic		F.O.B. Refinery — Electrolytic — Export	London Spot — Standard		London Spot — Electrolytic	
	1933	1934	1934	1933	1934	1933	1934
January	4.775	7.890	7.831	28.557	32.560	33.244	35.614
February	4.775	7.777	7.844	28.481	33.072	32.556	35.969
March	5.011	7.775	7.837	28.179	32.497	32.370	35.512
April	5.395	8.173	8.053	29.576	33.006	33.681	36.038
May	6.698	8.275	7.913	34.071	32.662	38.163	35.756
June	7.773	8.594	7.705	36.759	32.149	41.000	35.339
July	8.635			37.917		41.524	
August	8.768			36.071		40.227	
September	8.753			35.122		38.339	
October	7.950			33.656		36.977	
November	7.881			30.588		33.898	
December	7.885			31.306		34.329	
Year	7.025			32.524		36.359	

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1933	1934	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.000	4.000	2.875	3.900	10.458	10.833	11.304	11.517
February	3.000	4.000	2.875	3.900	10.431	10.719	11.634	11.913
March	3.146	4.000	3.021	3.900	10.609	10.821	11.545	11.842
April	3.260	4.179	3.135	4.042	10.872	11.122	11.500	11.794
May	3.654	4.140	3.525	3.990	12.095	12.372	11.051	11.341
June	4.173	3.975	4.023	3.825	13.280	13.571	11.054	11.253
July	4.452		4.303		13.411	13.613		
August	4.500		4.350		12.182	12.457		
September	4.500		4.350		11.932	12.229		
October	4.313		4.176		11.804	12.102		
November	4.288		4.146		11.537	11.778		
December	4.141		4.042		11.431	11.658		
Year	3.869		3.735		11.670	11.940		

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1933	1934	1933	1934
	Straits		Standard, Spot	
January	22.692	51.891	145.708	226.631
February	23.500	51.668	148.544	226.731
March	24.221	53.838	149.120	233.863
April	27.136	55.622	157.944	239.181
May	36.051	53.541	186.207	234.239
June	44.097	51.271	219.964	226.875
July	46.356		216.673	
August	44.794		215.210	
September	46.665		216.893	
October	47.858		223.455	
November	53.011		226.722	
December	52.936		227.678	
Year	39.110		194.510	

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.018	4.271	14.381	14.595	14.688	14.943
February	2.666	4.384	13.866	14.119	14.844	15.125
March	2.987	4.368	14.647	14.674	14.735	15.033
April	3.298	4.370	14.951	15.208	14.916	15.200
May	3.805	4.346	15.505	15.660	14.722	14.966
June	4.348	4.240	16.988	16.774	14.241	14.467
July	4.878		17.795	17.789		
August	4.916		16.869	17.031		
September	4.699		16.810	17.042		
October	4.748		16.310	16.599		
November	4.520		15.048	15.349		
December	4.461		14.826	15.059		
Year	4.029		15.666	15.825		

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1933	1934	1933	1934
January	55.000	55.000	23.300	23.300
February	55.000	55.000	23.300	23.300
March	55.000	55.000	23.300	23.300
April	55.000	55.000	23.300	23.300
May	55.000	55.000	23.300	23.300
June	55.000	55.000	23.300	23.300
July	55.000		23.300	
August	55.000		23.300	
September	55.000		23.300	
October	55.000		23.300	
November	55.000		23.300	
December	55.000		23.300	
Year	55.000		23.300	

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1933	1934	1933	1934	1933	1934
January	5.722	7.198	48.500	67.538	26.480	38.000
February	5.738	7.172	48.614	72.011	24.000	38.000
March	5.901	7.545	52.676	75.472	24.667	38.000
April	5.876	7.918	54.580	75.930	26.800	38.000
May	6.264	8.465	56.500	75.577	28.500	36.538
June	6.500	7.900	60.038	75.000	30.000	36.000
July	7.262		62.900		32.320	
August	6.986		63.500		33.000	
September	6.880		64.580		34.560	
October	6.843		66.500		36.000	
November	7.113		66.000		37.583	
December	7.250		66.330		38.000	
Year	6.528		59.227		30.993	

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1933	1934	1933	1934	1933	1934
January	14.50	18.00	14.00	17.00	14.50	17.50
February	14.50	18.00	14.00	17.00	14.50	17.50
March	14.50	18.00	14.00	17.00	14.50	17.50
April	14.50	18.48	14.00	17.48	14.50	17.98
May	15.42	19.00	14.42	18.00	14.92	18.50
June	16.00	19.00	15.00	18.00	15.50	18.50
July	16.50		15.50		16.00	
August	17.00		16.00		16.50	
September	18.00		17.00		17.50	
October	18.00		17.00		17.50	
November	18.00		17.00		17.50	
December	18.00		17.00		17.50	
Year	16.24		15.41		15.91	

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces